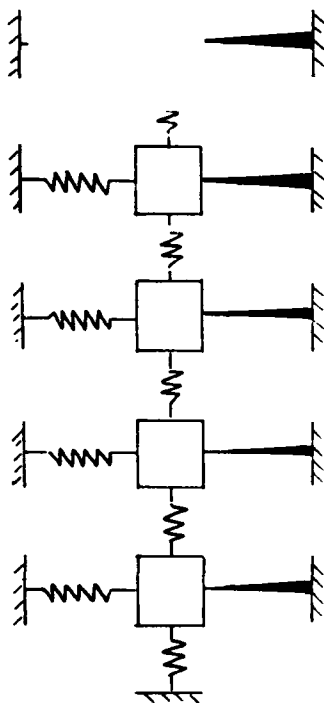




US Army Corps  
of Engineers

AD A139621



TECHNICAL REPORT K-84-1

# LOAD-TRANSFER CRITERIA FOR NUMERICAL ANALYSIS OF AXIALLY LOADED PILES IN SAND

## PART II: LOAD PILE CAPACITY CURVES FOR STEEL AND CONCRETE PILES

by

Reed L. Mosher

Automatic Data Processing Center  
U. S. Army Engineer Waterways Experiment Station  
P. O. Box 631, Vicksburg, Miss. 39180



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Prepared for U. S. Army Engineer Division,  
Lower Mississippi Valley  
P. O. Box 80, Vicksburg, Miss. 39180

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LOAD-TRANSFER CRITERIA FOR NUMERICAL ANALYSIS  
OF AXIALLY LOADED PILES IN SAND

PART II: LOAD PILE CAPACITY CURVES  
FOR STEEL AND CONCRETE PILES

CHAPTER 1: INTRODUCTION

This report presents load capacity curves for the design and analysis of axially loaded piles. A brief discussion of the contents of this report and the applicability of the curves follows. In order to make intelligent use of these curves, the reader should have a thorough knowledge of the criteria used in their development. These criteria are presented in Part I of this report.

Development of Curves

From the criteria presented in Part I and the computer program PILOAD for generating load capacity data and PIPILOT for plotting the data, a series of curves was developed for various pile types and sizes. For each pile, the total, side, and tip capacities are presented. In addition, for each pile, thirteen different surcharge loads applied at the surface and four different internal friction angles were considered. The surcharge loads range from 0 to 3000 psf. They are accounted for by computing an equivalent depth which in turn is used to compute the maximum tip and side resistance. Values of the internal friction angles are 30, 33, 35, and 37 degrees.

The pile capacity is defined as the total load corresponding to 0.25 inch of tip movement.

The curves should not be used without careful consideration of the soil conditions. The curves were developed assuming homogeneous soils and use of the curves with nonhomogeneous materials may give misleading results. See Part I for a discussion of the subject.

The curves presented are for steel piles, concrete piles, and concrete-filled steel pipe piles. The modulus of elasticity used for the steel piles is 29,000,000 psi and for the concrete piles 4,000,000 psi. For the composite piles the modulus is computed as follows.



$$E_{com} = \frac{E_s A_s + E_c A_c}{A_s + A_c}$$

where

- $E_s$  = modulus of elasticity of steel
- $A_s$  = area of steel
- $E_c$  = modulus of elasticity of concrete
- $A_c$  = area of concrete

#### Procedure for Partially Submerged Piles

The curves presented herein are for completely submerged piles. To utilize the curves for partially submerged piles the following procedure is suggested:

- a. Determine the pile length, surcharge load, and other parameter as if the piles were completely submerged.
- b. Determine the depth of the unsubmerged soil.
- c. Find the difference between the total unit weight and submerged unit weight, and multiply this value by the depth of the unsubmerged soil.
- d. Take half of value obtained in c and consider it as an additional surcharge load to be added to the previously determined surcharge load.
- e. Determine the pile capacity using this modified surcharge load value.

Lowering the water table in the vicinity of a pile causes an increase in the effective stress in the surrounding soil mass which in turn increases the pile capacity. The change in effective stress starts at the ground surface and increases proportionally with depth until the water table is reached. At that point, the effective stress remains constant with increasing depth, Figure 1. The load-transfer criteria used in developing the curves presented in this part account for this increased effective stress by an adjustment to the relative depth as if a surcharge load was present. The relative depth is used to determine the maximum side and tip resistances of a pile. An example of this approach is presented in Appendix E, Part I. To approximate this effect with the pile curves, half of the total increase in weight of soil from lowering the water table is applied as a surcharge load, Figure 2. A comparison of this procedure was conducted for two different pile types and several



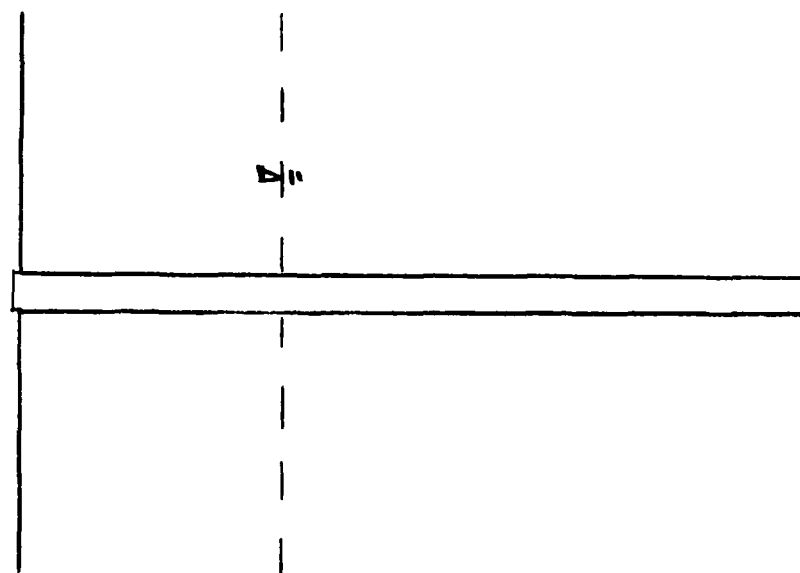
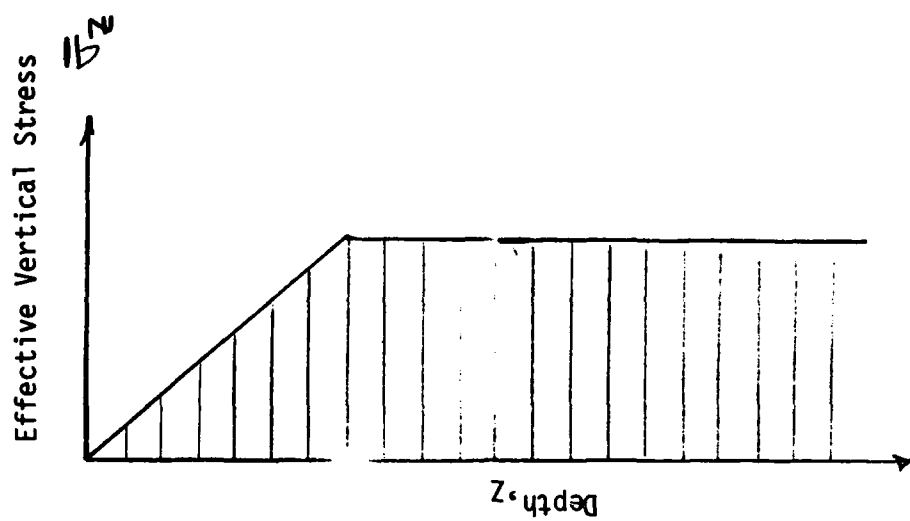


Figure 1. Increase in Effective Vertical Stress from Lowering of the Water Table



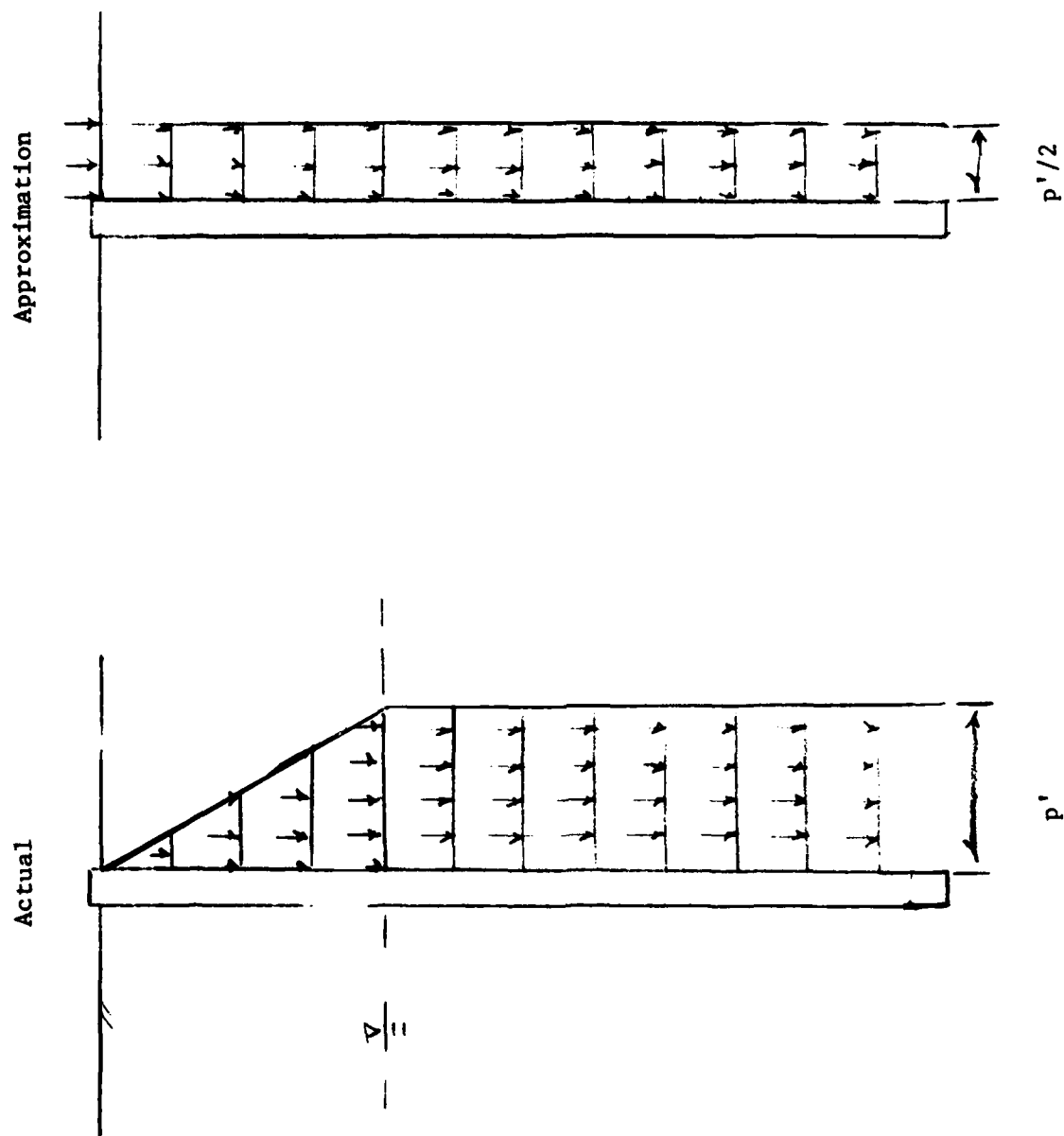


Figure 2. Approximation for Pile Curves When Piles are Partially Submerged



different ground water levels are presented in Table 1. The comparison reveals that the procedure outlined above provides a reasonable estimate of the effects of partially submerged piles.

#### Use of Load Capacity Curves

To use the curves, first determine the pile type and length along with the expected surcharge load and internal friction angle. With these values select the appropriate graph and locate the pile length on the vertical axis. Project a line horizontally until it intersects the curve having the appropriate surcharge load. Next draw a vertical line to the horizontal axis and read the pile capacity. An example follows.



Table 1

Water level from Surface	0 Ft.		10 Ft.		20 Ft.		30 Ft.	
	Computed	Curves	Computed	Curves	Computed	Curves	Computed	Curves
*12 HP53	135	135	147	149	153	155	160	161
Square 16" Con.	175	175	202	196	209	205	216	215



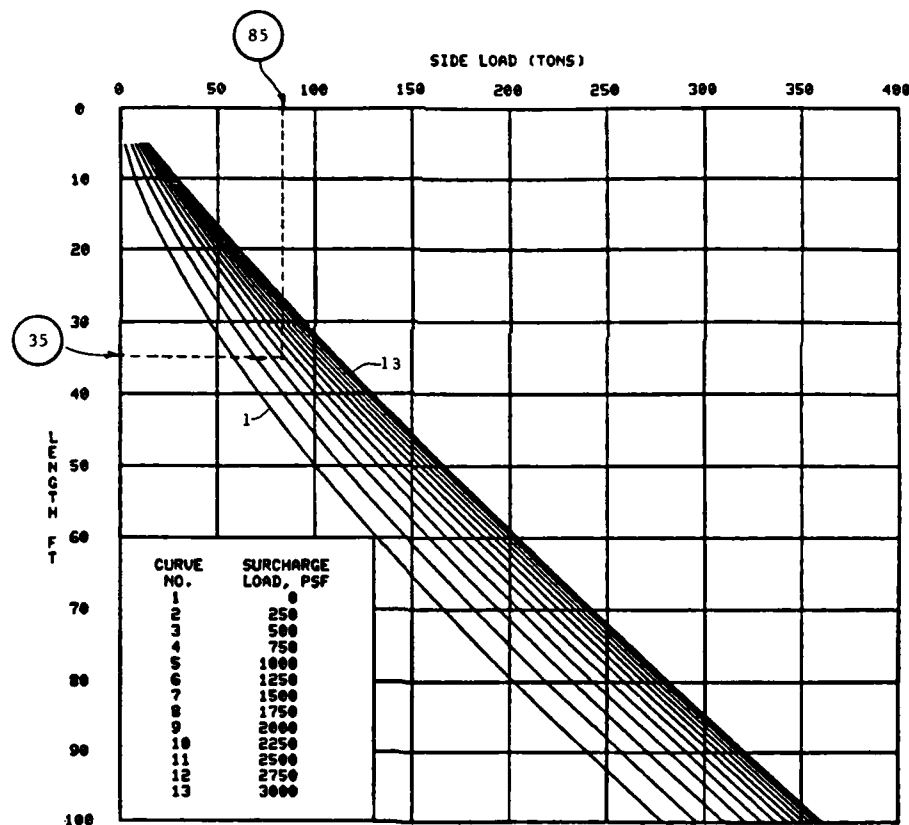
### EXAMPLE PROBLEM

Given a 20-in. steel pipe pile embedded 35 ft in a sand.  $\phi = 35^\circ$ ,  
surcharge load = 750 psf.

Determine the side load capacity.

Enter the appropriate graph at a length of 35 ft. Project a horizontal line to curve number 4 which corresponds to a surcharge load of 750 psf. Project this point vertically to the horizontal axis.

The side load capacity = 85 tons.



Side Capacity For A 20-in Steel Pipe Pile,  
Submerged Condition, 1/4-in. Tip Movement,  $\Phi=35^\circ$  Deg.,  $C=0$ .



## CHAPTER 2: LOAD CAPACITY CURVES FOR STEEL H PILES

Total pile, side, and pit capacity curves for steel H piles are presented as follows:

<u>Curves for</u>	<u>Shown in Figure</u>
10HP42	3-14
12HP53	15-26
14HP73	27-38
14HP89	39-50



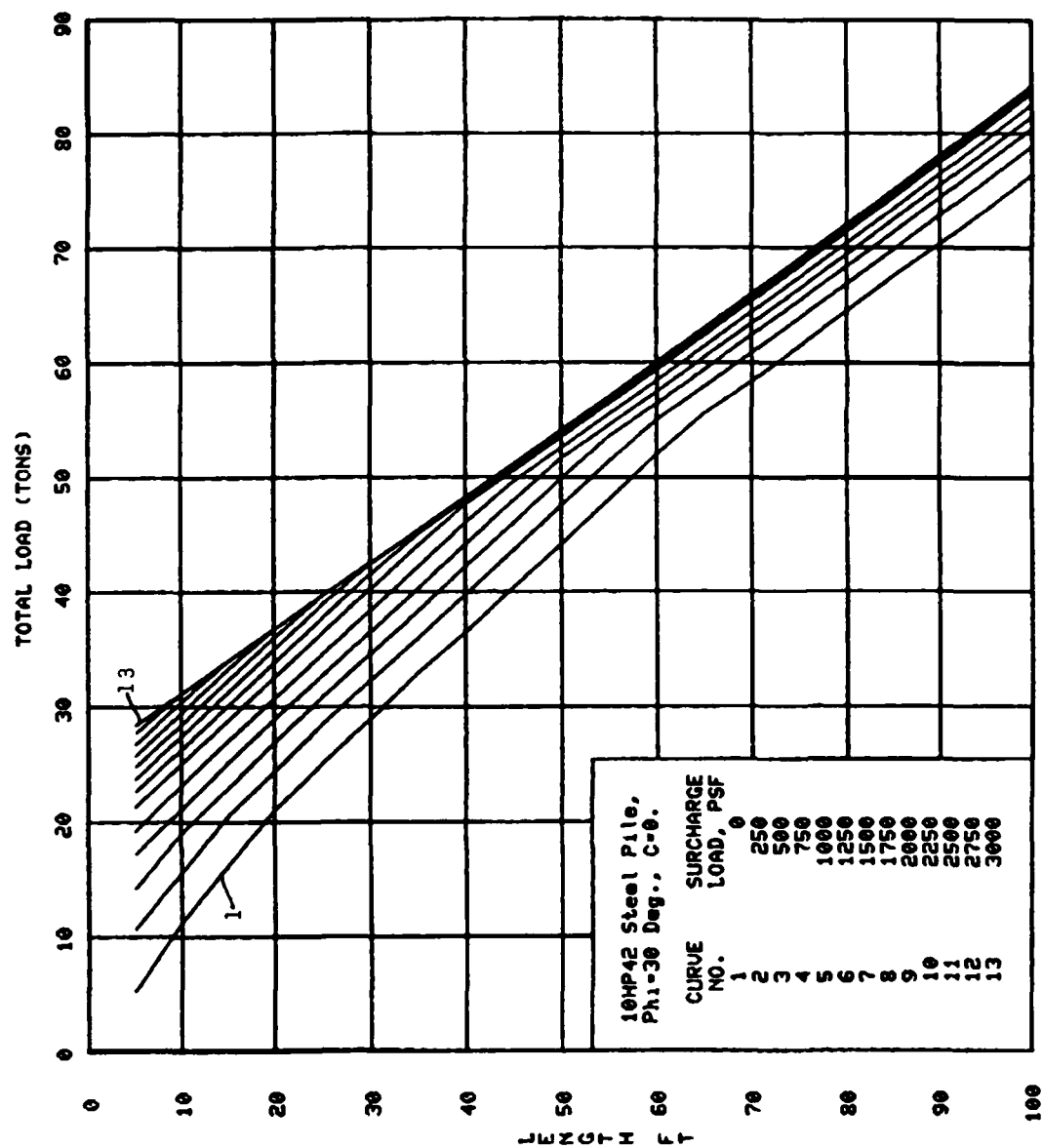


Figure 3. Total Pile Capacity For A 10HP42 Steel Pile,  
 Submerged Condition, 1/4-in. Tip Movement,  $\Phi_1=30$  Deg.,  $C=0$ .



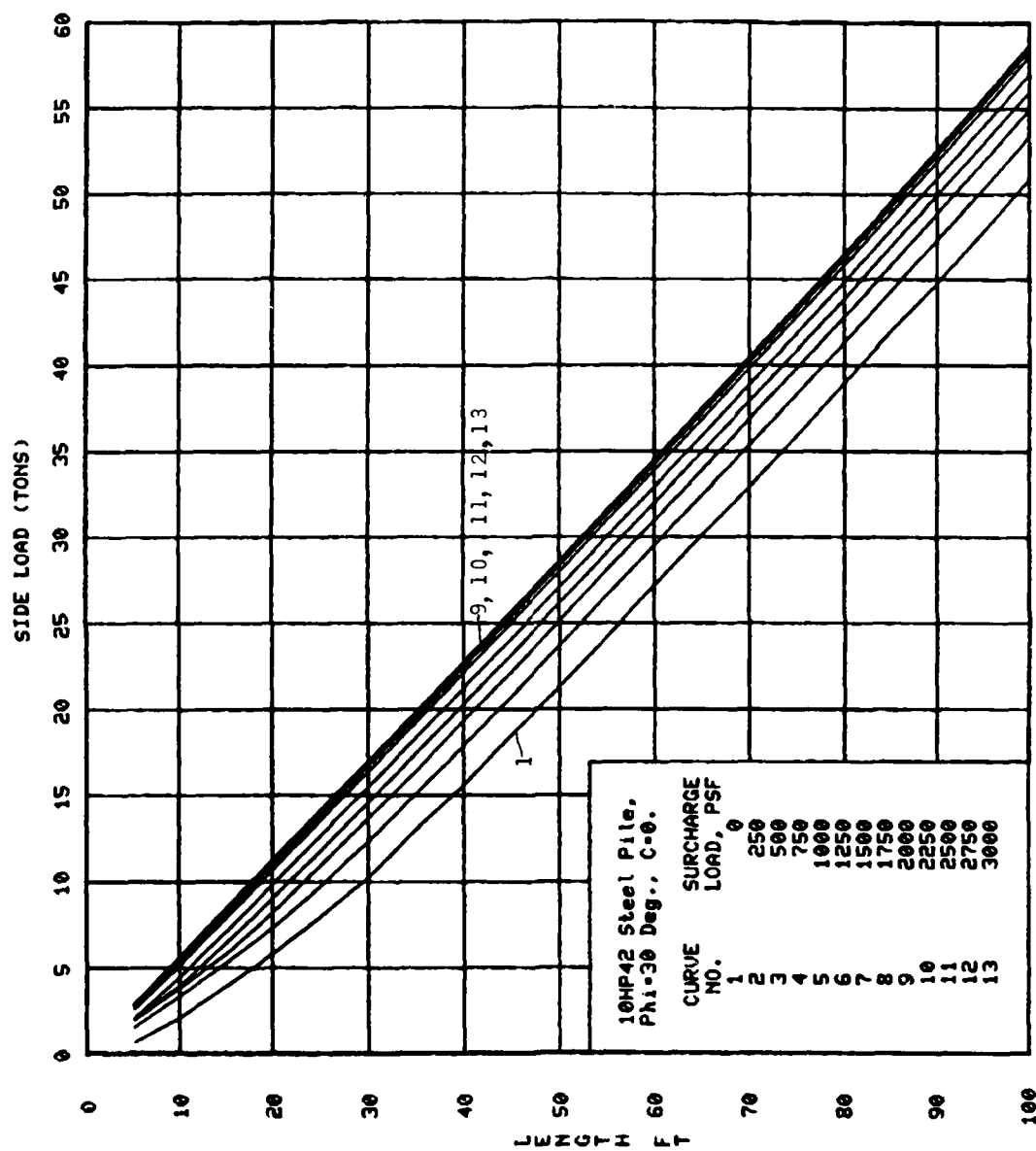


Figure 4. Side Capacity For A 10HP42 Steel Pile,  
 Submerged Condition, 1/4-in. Tip Movement,  $\Phi=30$  Deg.,  $C=0$ .



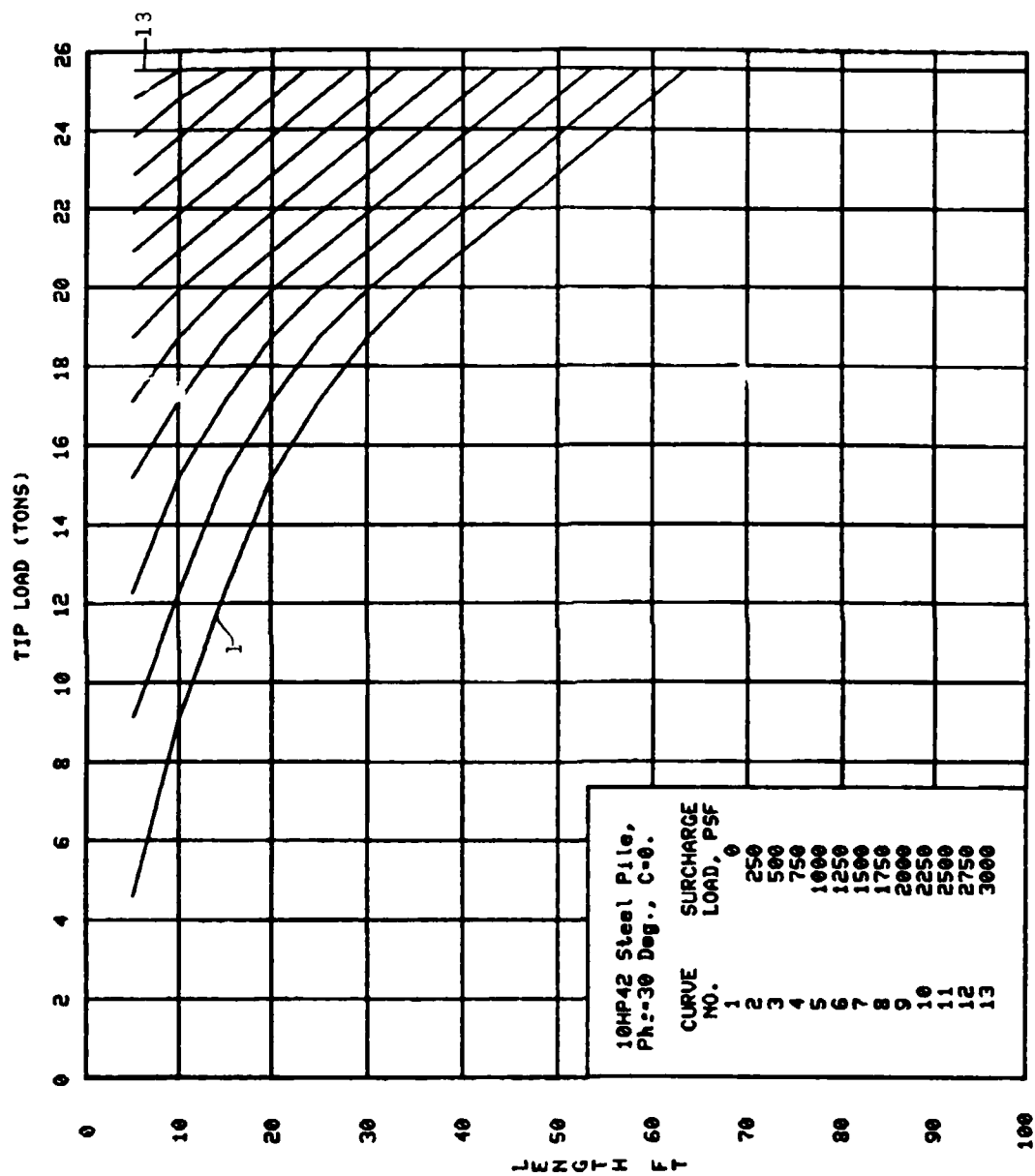


Figure 5. Tip Capacity For A 10HP42 Steel Pile,  
Submerged Condition, 1/4-in. Tip Movement, Phi=30 Deg., C=0.



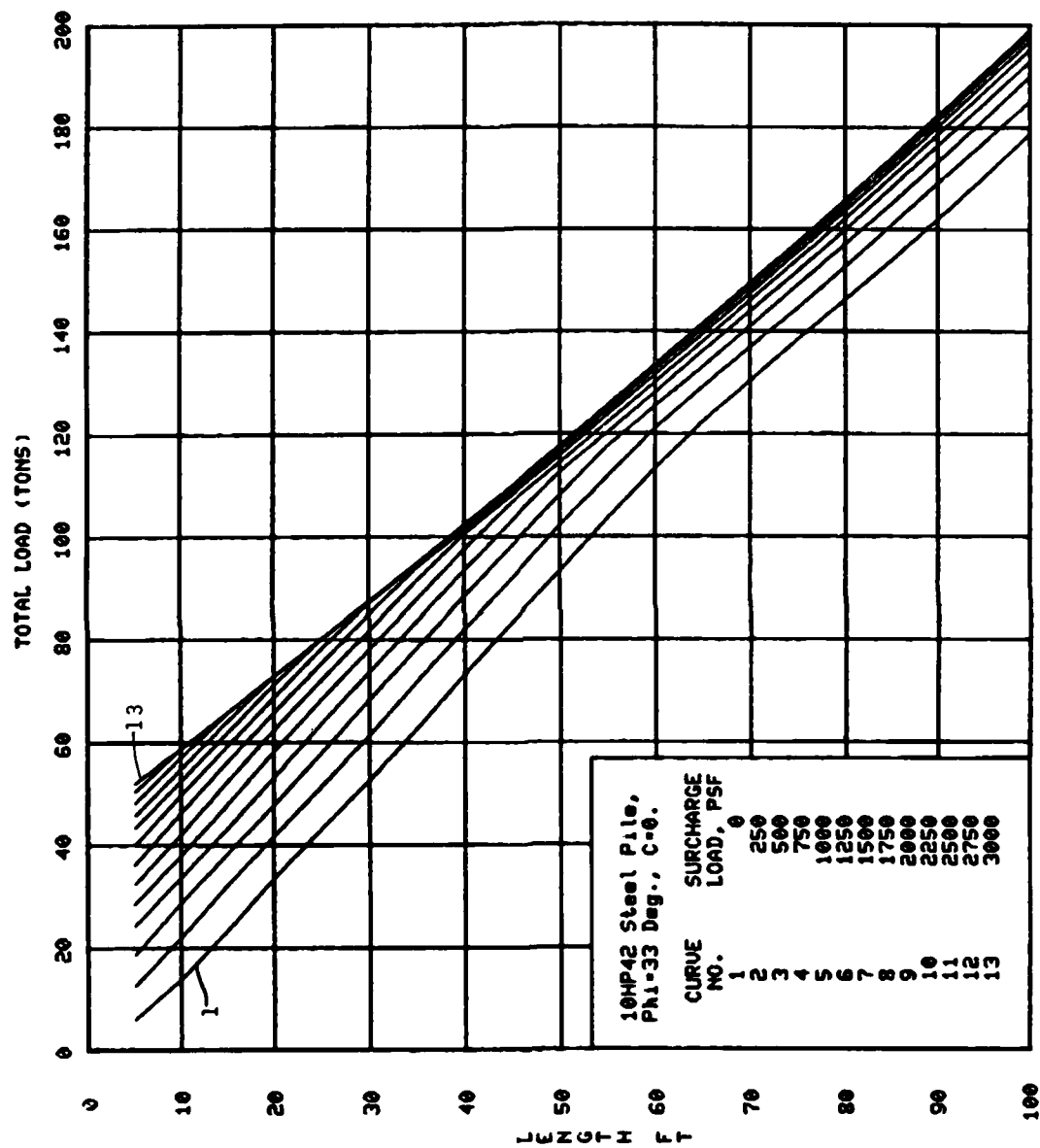


Figure 6. Total Pile Capacity For A 10HP42 Steel Pile,  
Submerged Condition, 1/4-in. Tip Movement, Phi=33 Deg., C=0.



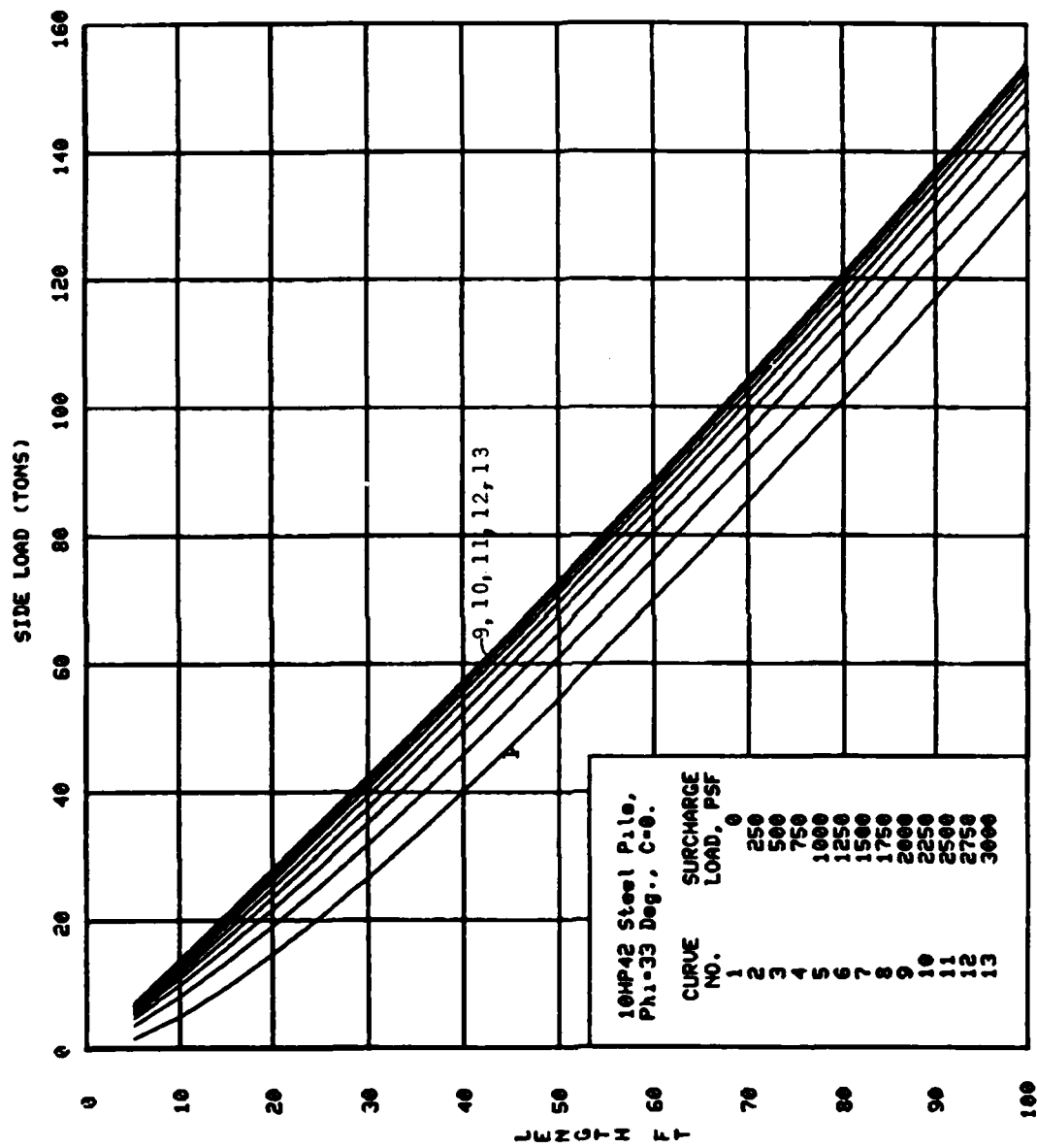


Figure 7. Side Capacity For A 10HP42 Steel Pile,  
Submerged Condition, 1/4-in. Tip Movement, Phi=33 Deg., C=0.



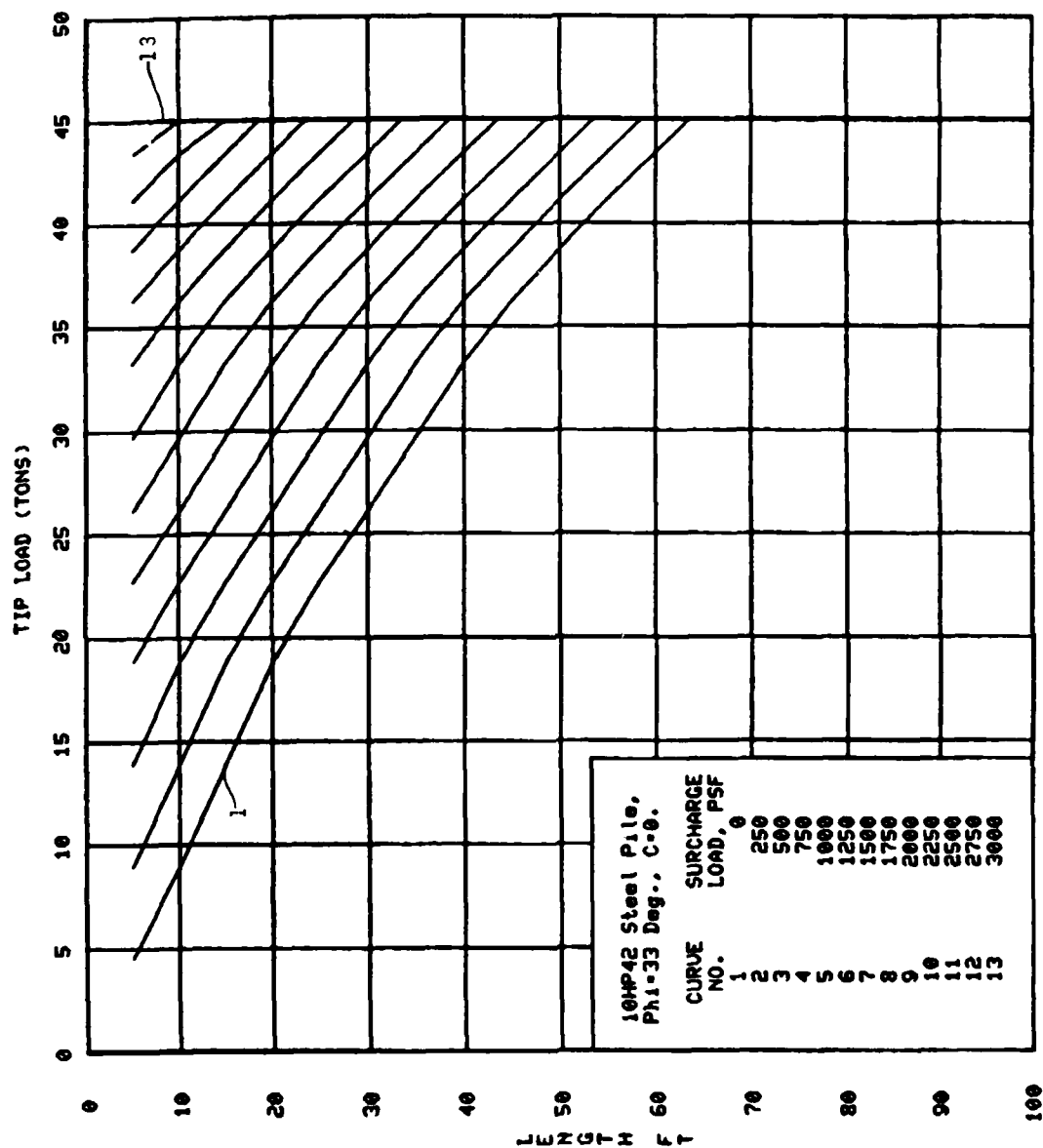


Figure 8. Tip Capacity For A 10HP42 Steel Pile,  
Submerged Condition, 1/4-in. Tip Movement, Phi=33 Deg., C=0.



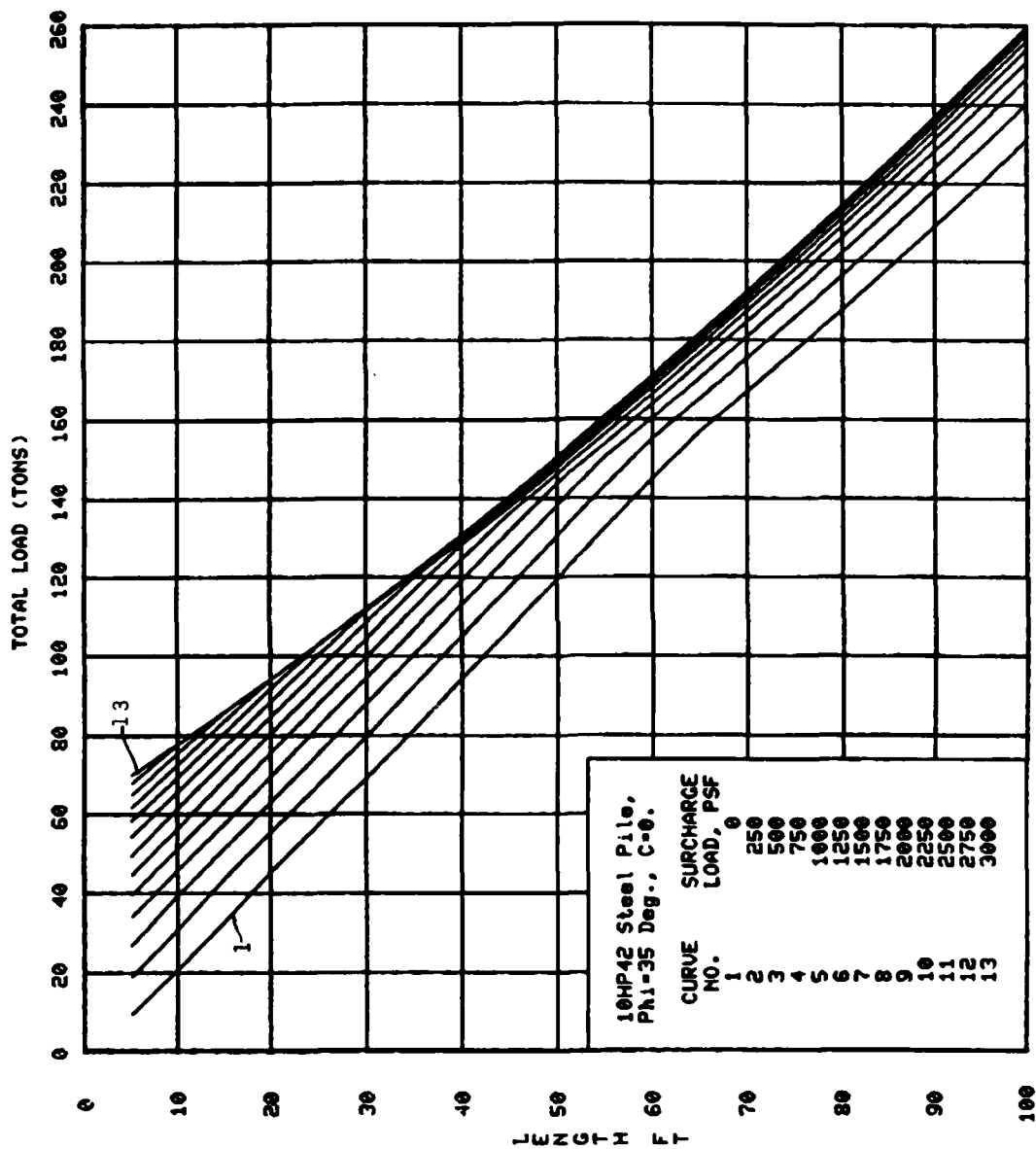


Figure 9. Total Pile Capacity For A 10HP42 Steel Pile,  
Submerged Condition, 1/4-in. Tip Movement, Phi=35 Deg., C=0.



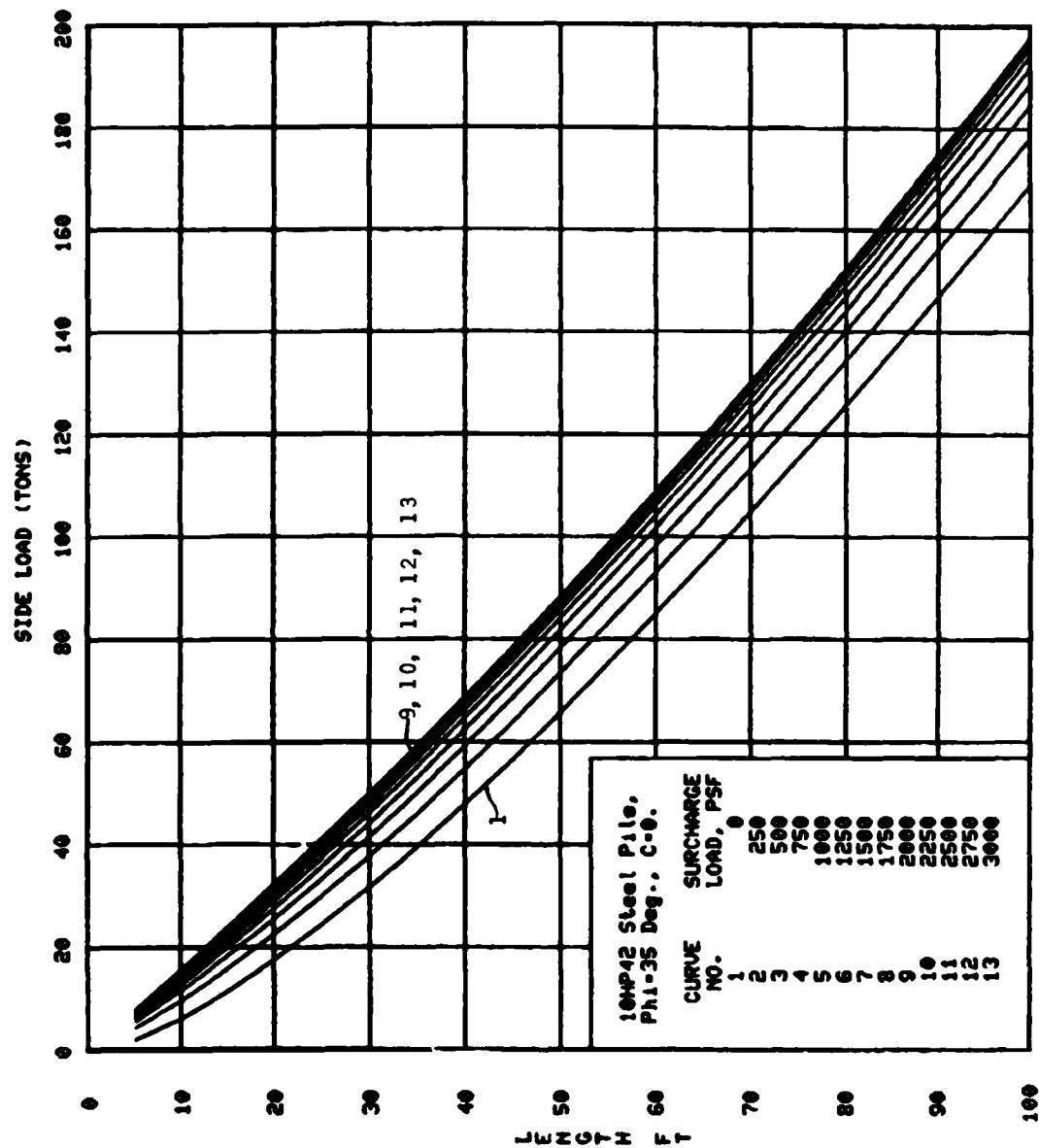


Figure 10. Side Capacity For A 10HP42 Steel Pile,  
 Submerged Condition, 1/4-in. Tip Movement,  $\Phi=35^\circ$  Deg., C=0.



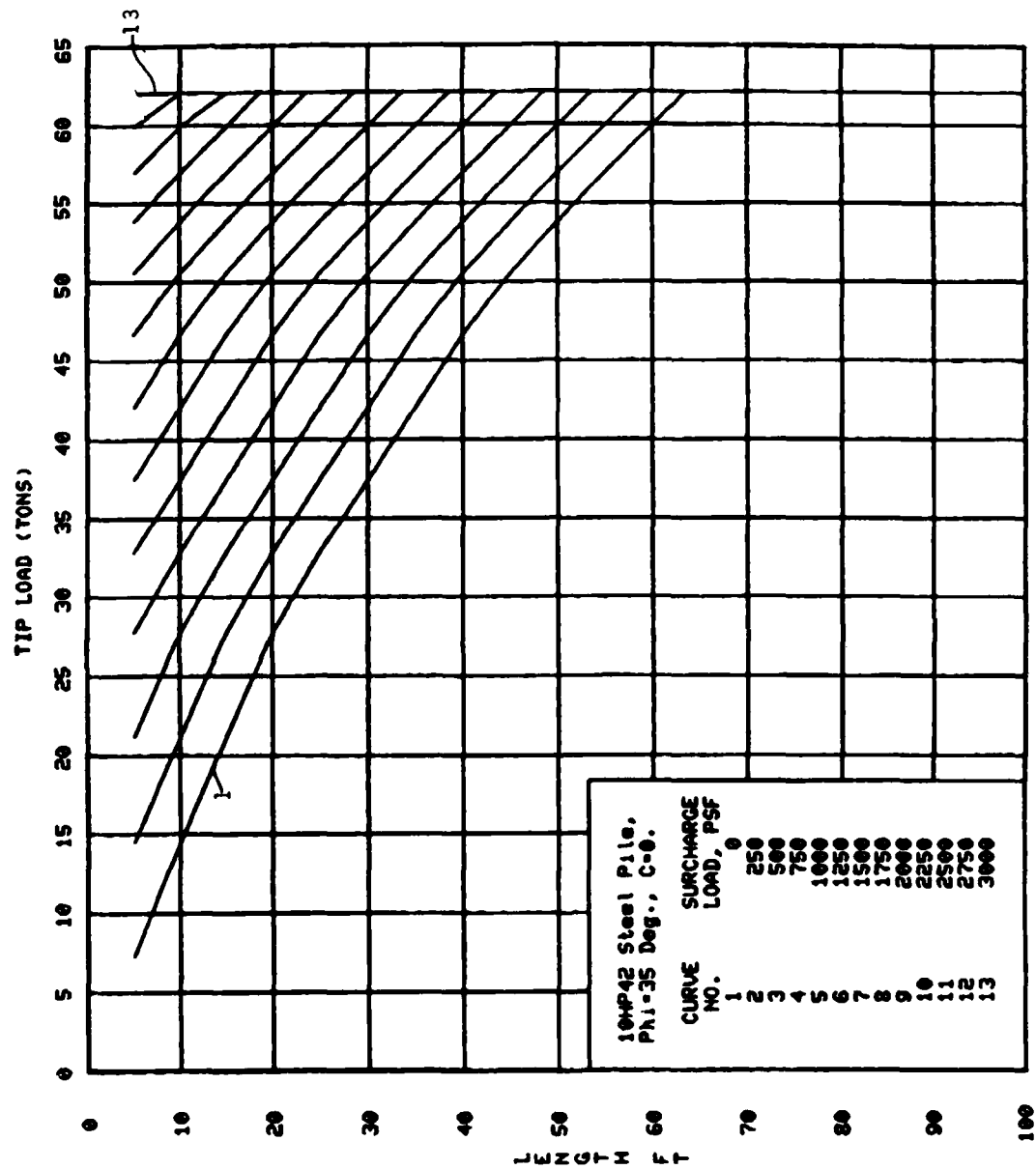


Figure 11. Tip Capacity For A 10HP42 Steel Pile,  
Submerged Condition, 1/4-in. Tip Movement, Phi=35 Deg., C=0.



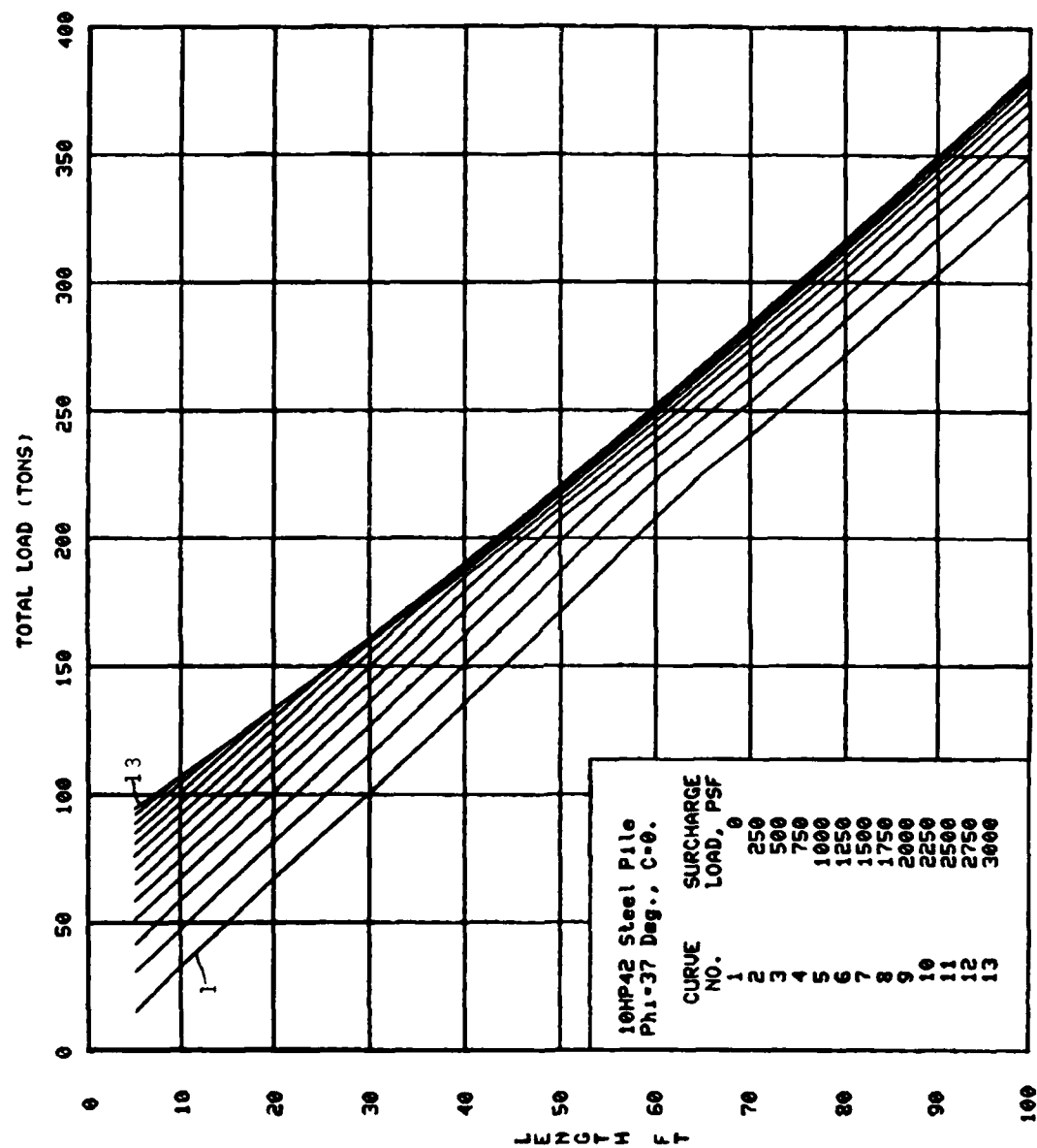


Figure 12. Total Pile Capacity For A 10HP42 Steel Pile  
 Submerged Condition, 1/4-in. Tip Movement,  $\Phi_1=37^\circ$  Deg.,  $C=0$ .



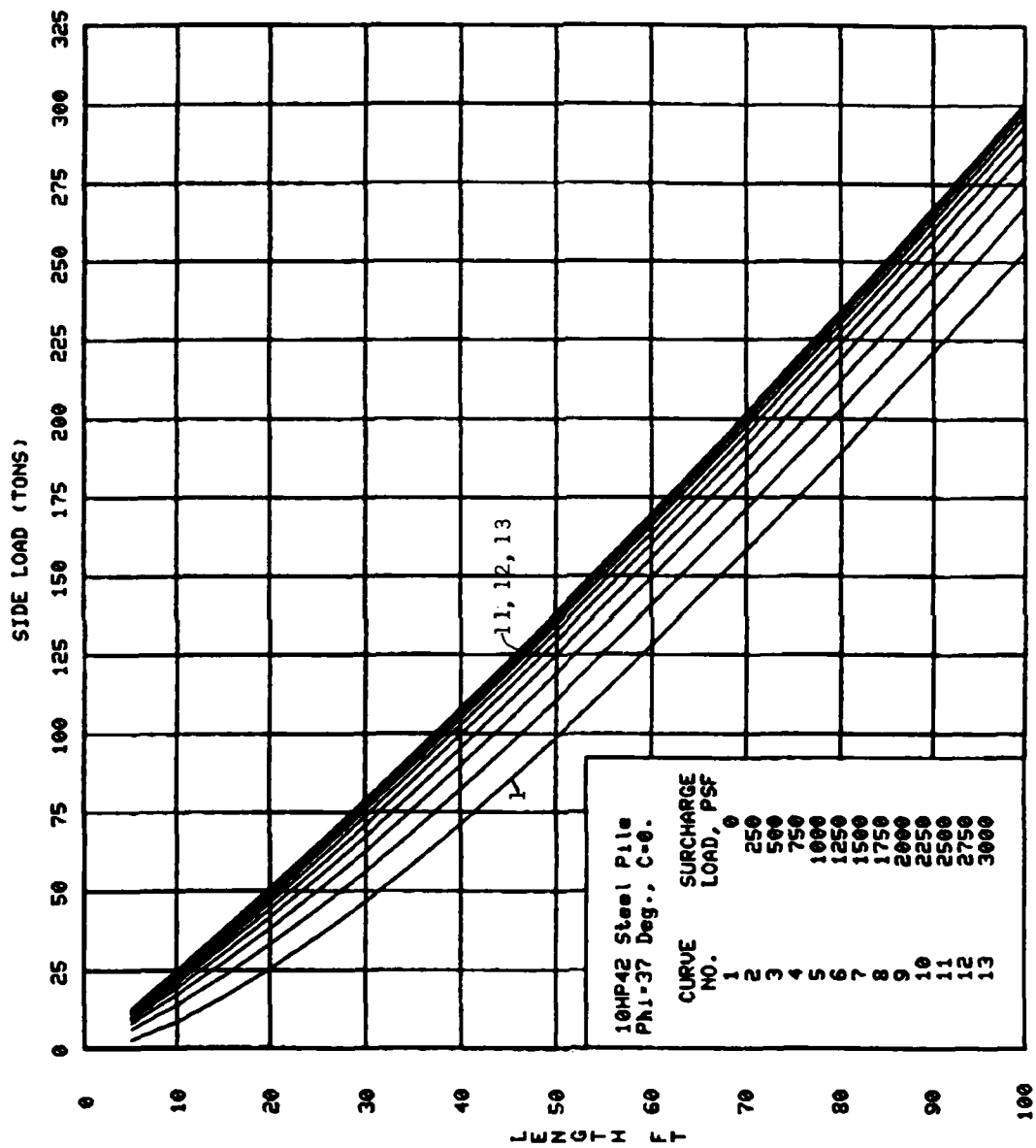


Figure 13. Side Capacity For A 10HP42 Steel Pile  
Submerged Condition, 1/4-in. Tip Movement, Phi=37 Deg., C=0.



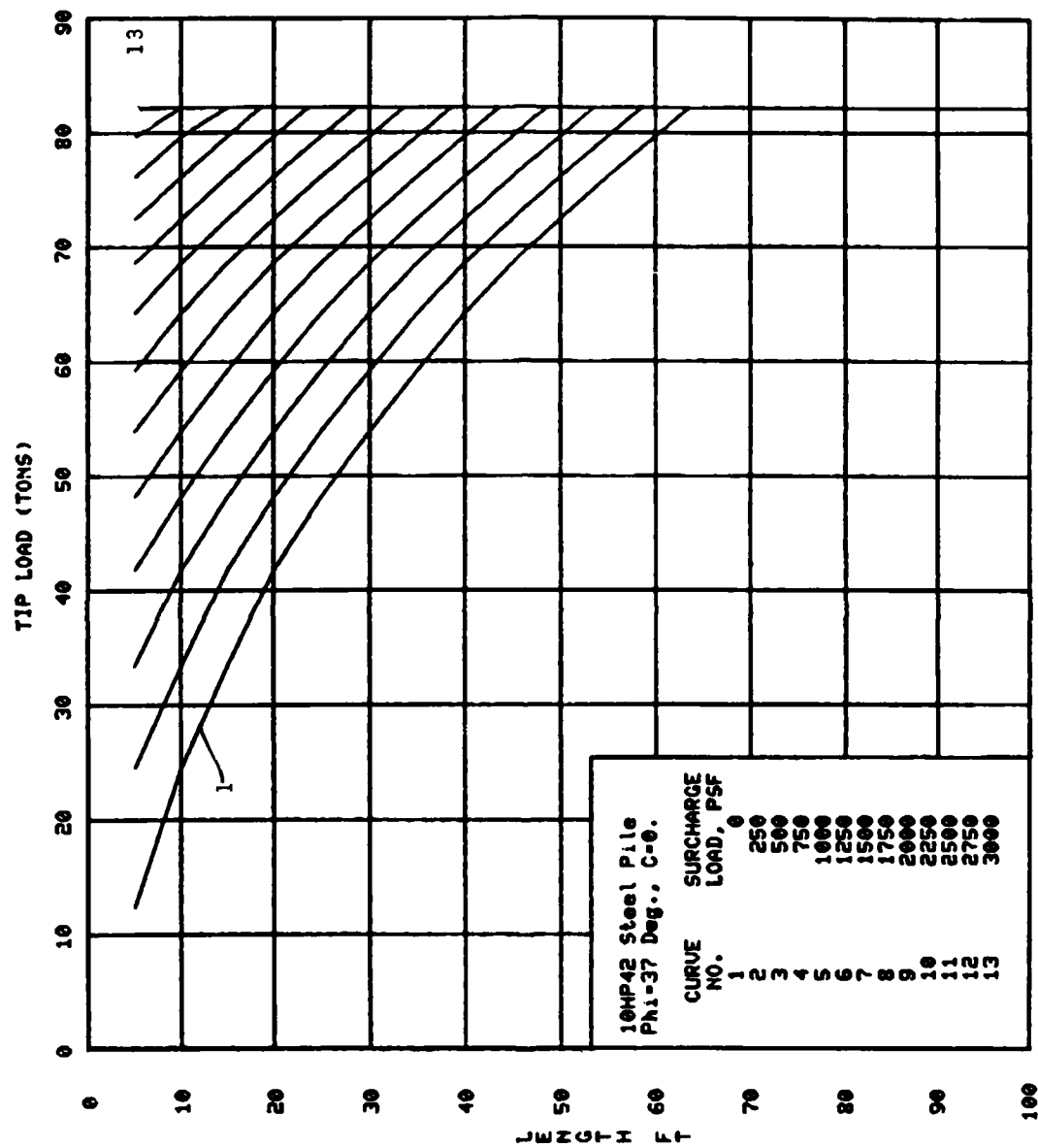


Figure 14. Tip Capacity For A 10HP42 Steel Pile  
Submerged Condition, 1/4-in. Tip Movement, Phi=37 Deg., C=0.



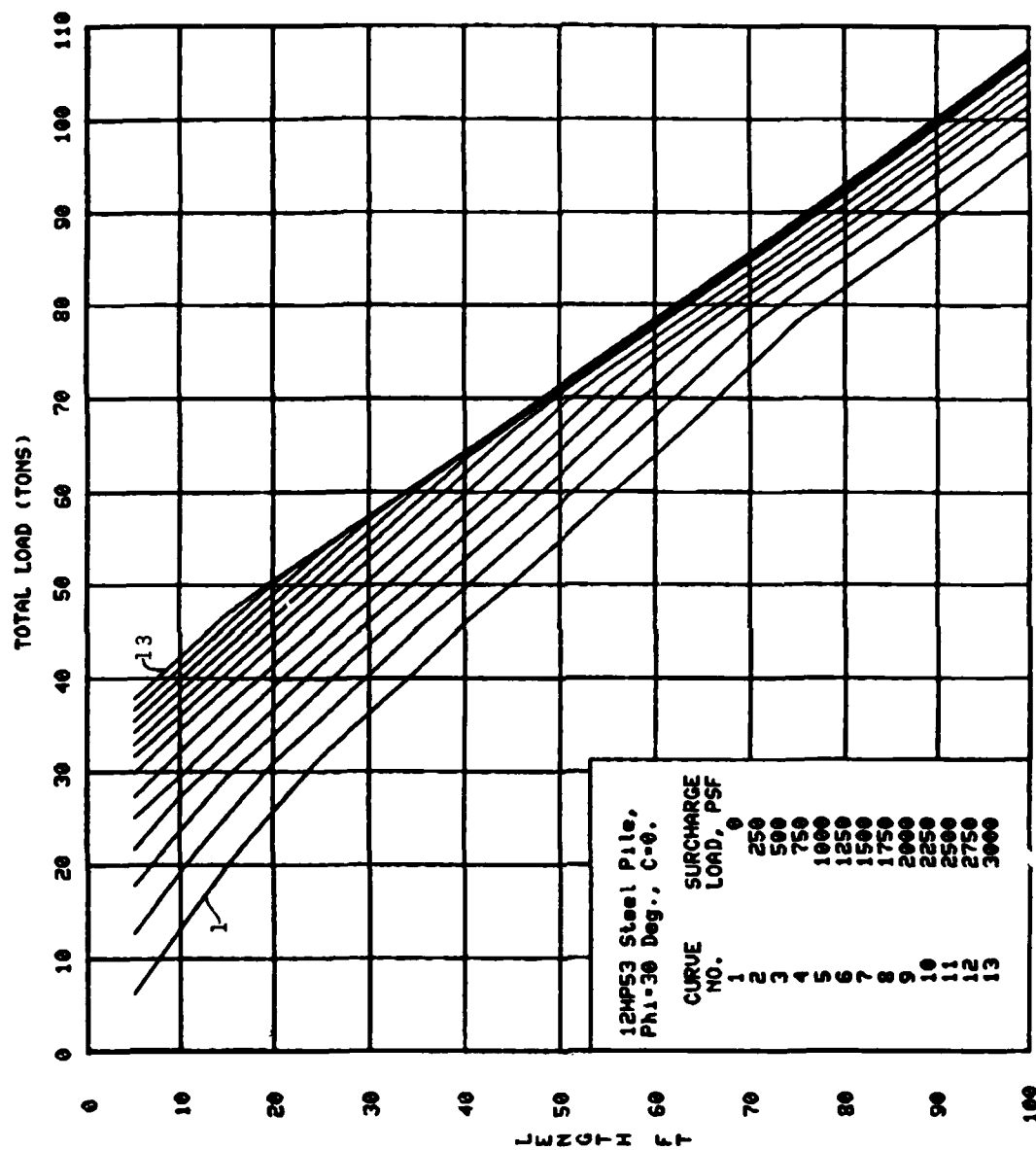


Figure 15. Total Pile Capacity For A 12HP53 Steel Pile,  
Submerged Condition, 1/4-in. Tip Movement, Phi=30 Deg., C=0.



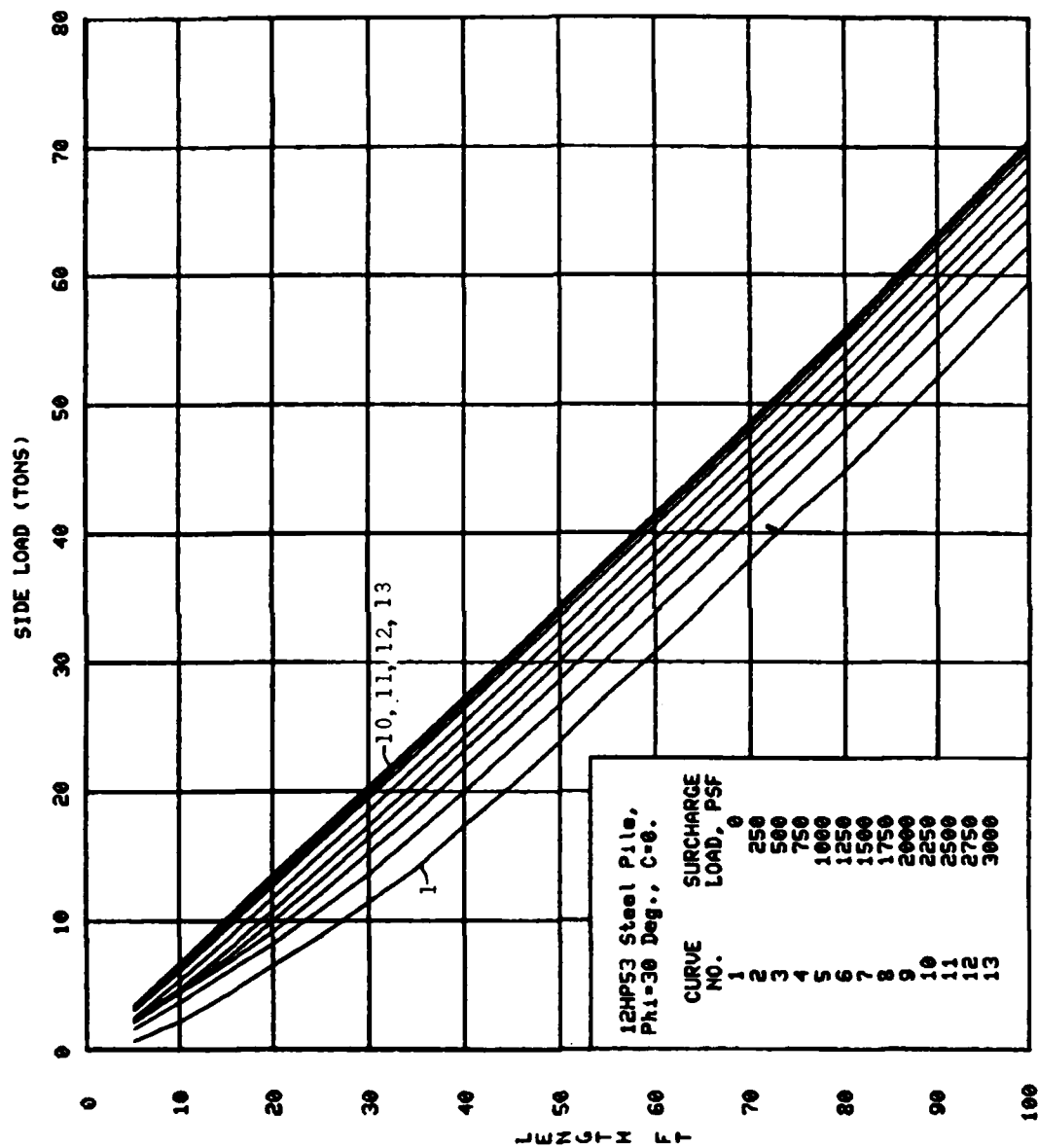


Figure 16. Side Capacity For A 12HP53 Steel Pile, Submerged Condition, 1/4-in. Tip Movement, Phi=30 Deg., C=0.



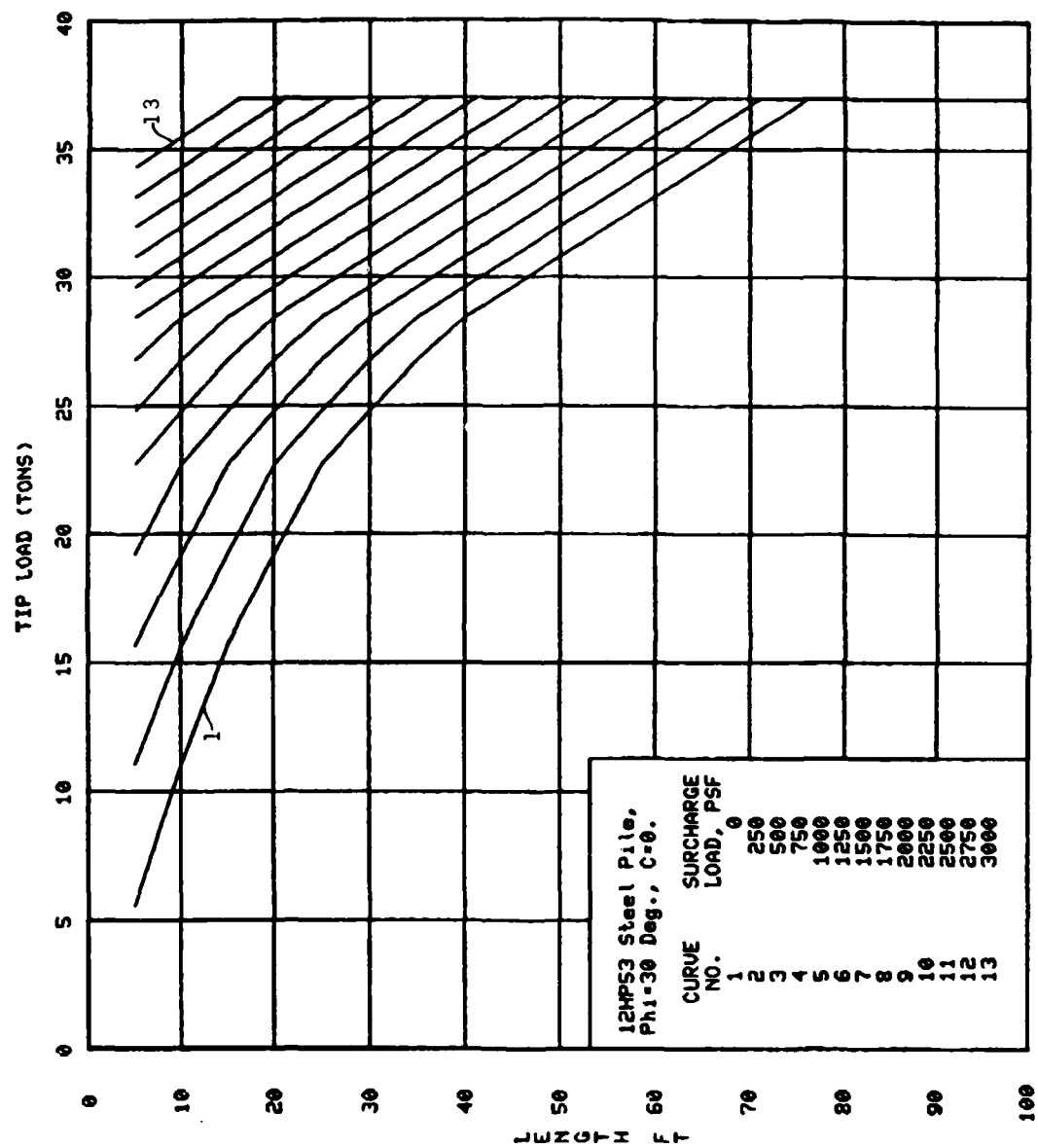


Figure 17. Tip Capacity For A 12HP53 Steel Pile,  
Submerged Condition, 1/4-in. Tip Movement, Phi=30 Deg., C=0.



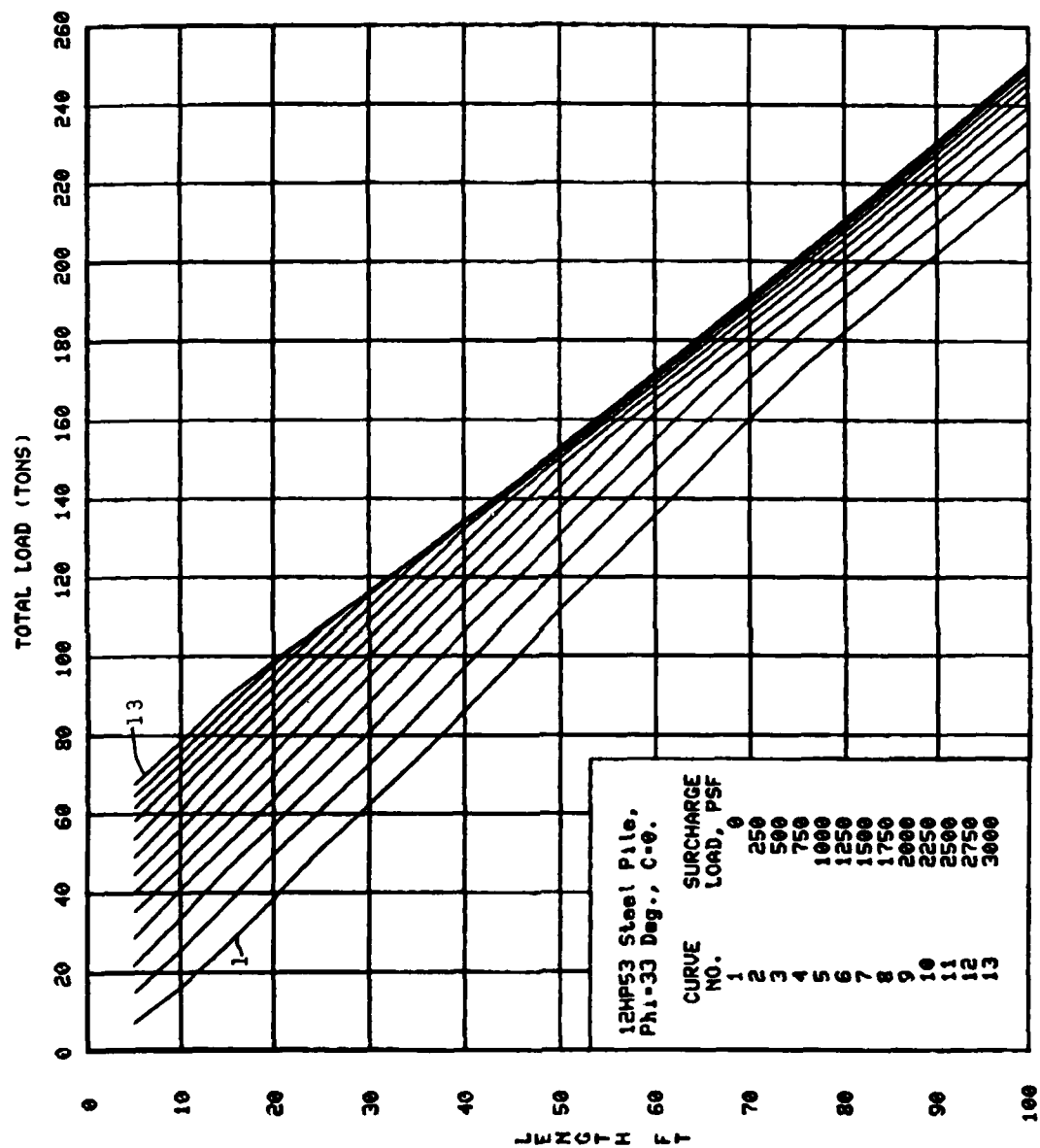


Figure 18. Total Pile Capacity For A 12HP53 Steel Pile,  
Submerged Condition, 1/4-in. Tip Movement, Phi=33 Deg., C=0.



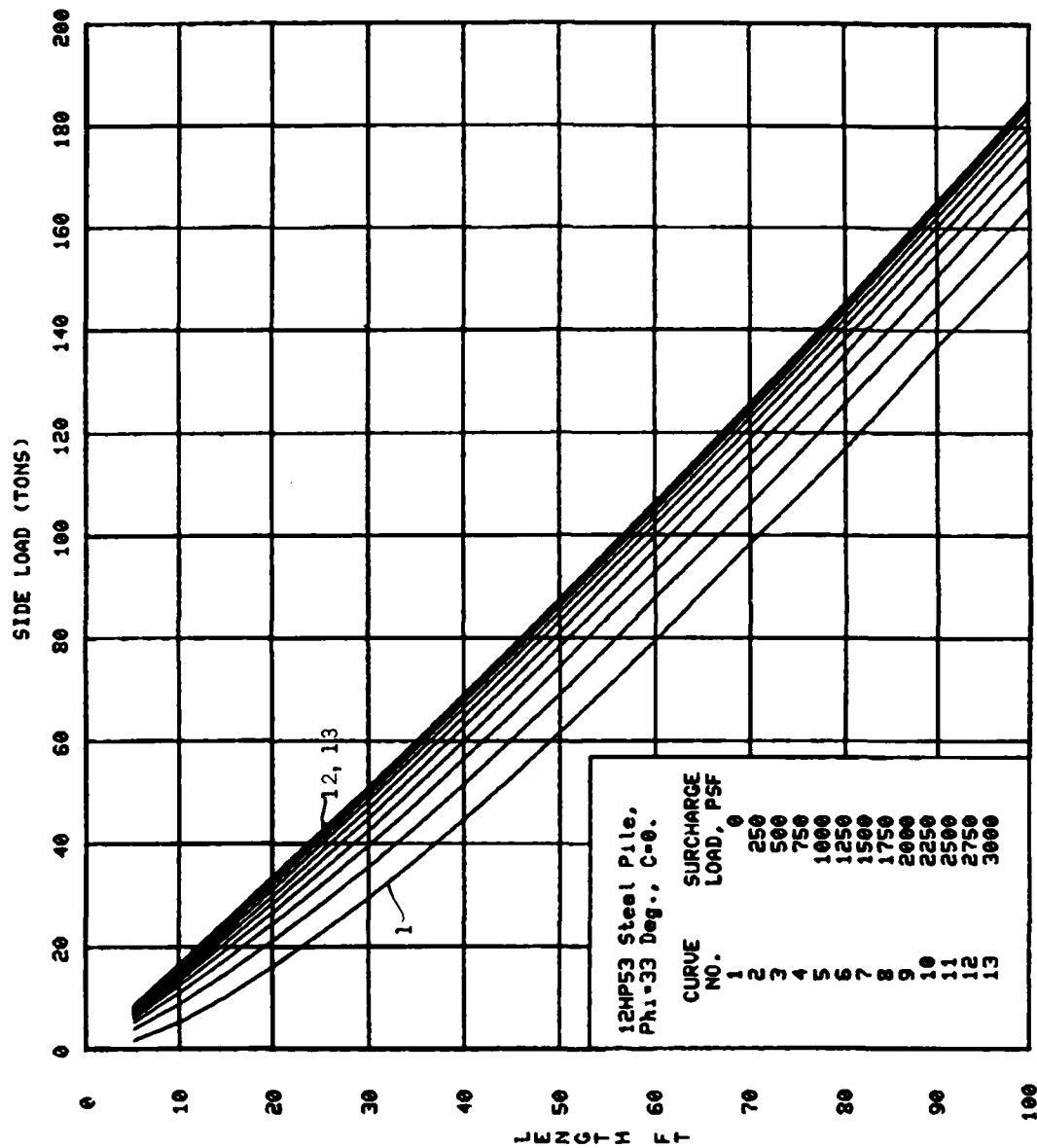


Figure 19. Side Capacity For A 12HP53 Steel Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi_1=33$  Deg.,  $C=0$ .



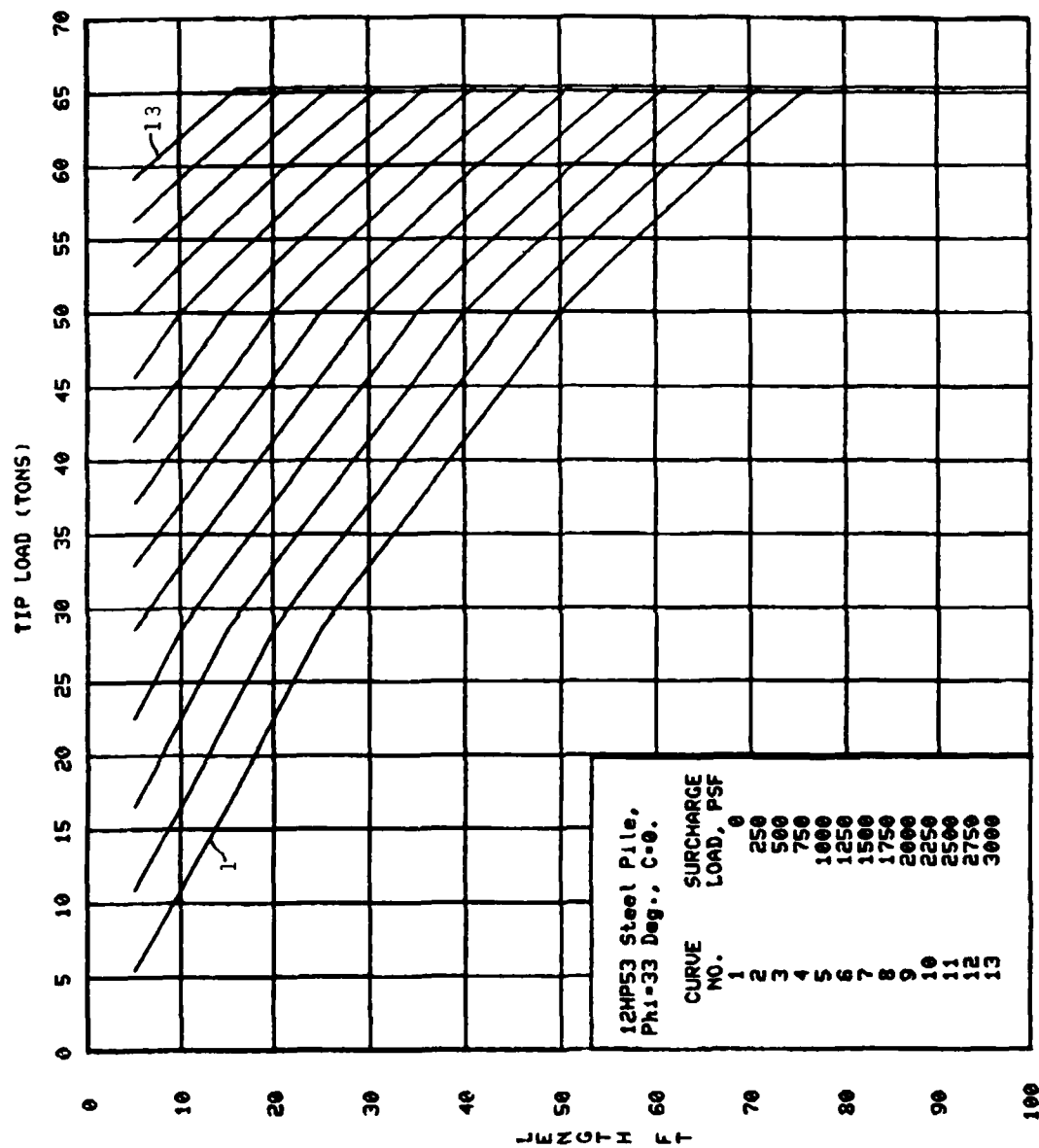


Figure 20 Tip Capacity For A 12HP53 Steel Pile,  
 Submerged Condition,  $1/4$ -in. Tip Movement,  $\Phi=33$  Deg.,  $C=0$ .



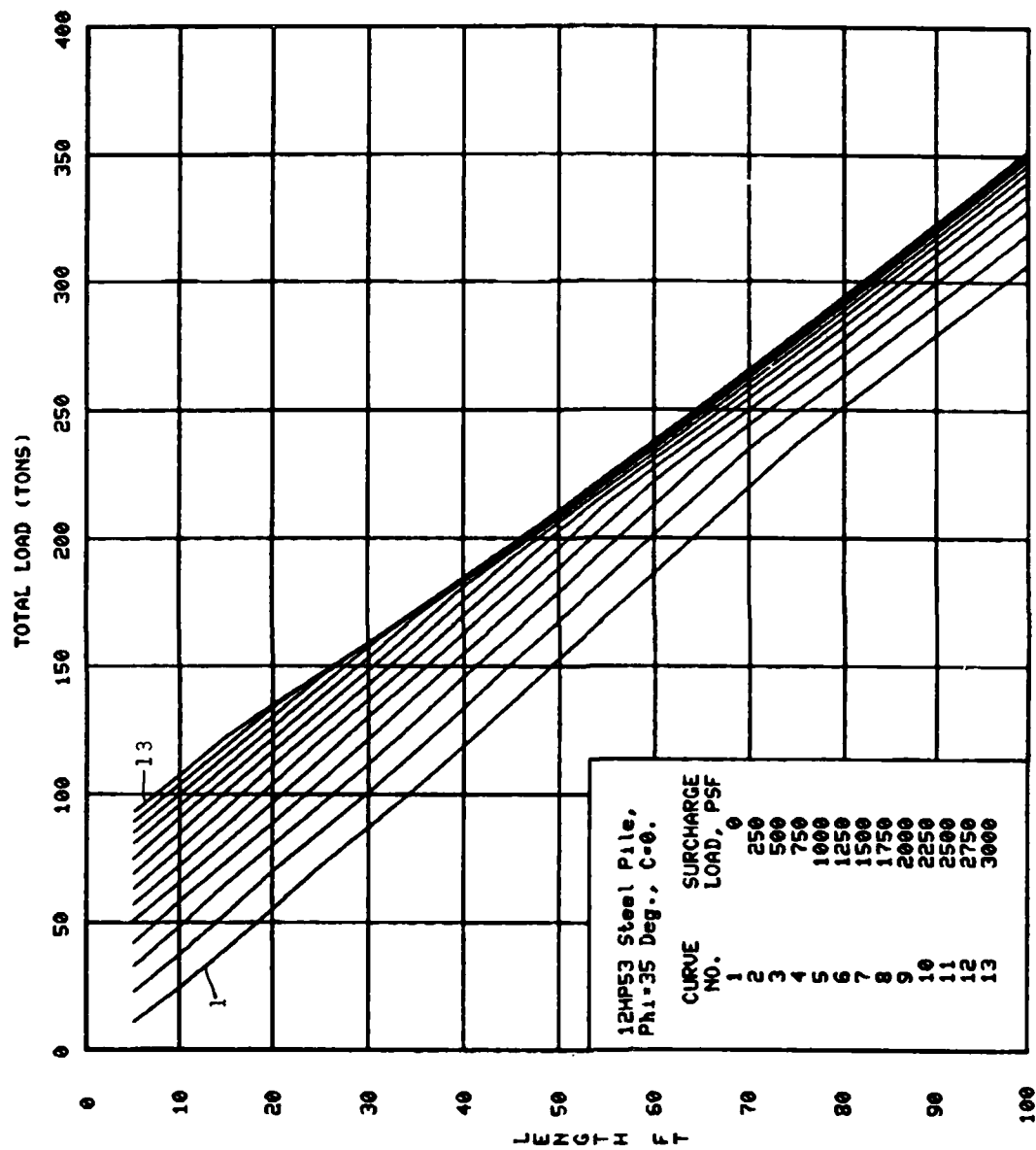


Figure 21. Total Pile Capacity For A 12HP53 Steel Pile,  
Submerged Condition, 1/4-in. Tip Movement, Phi=35 Deg., C=0.



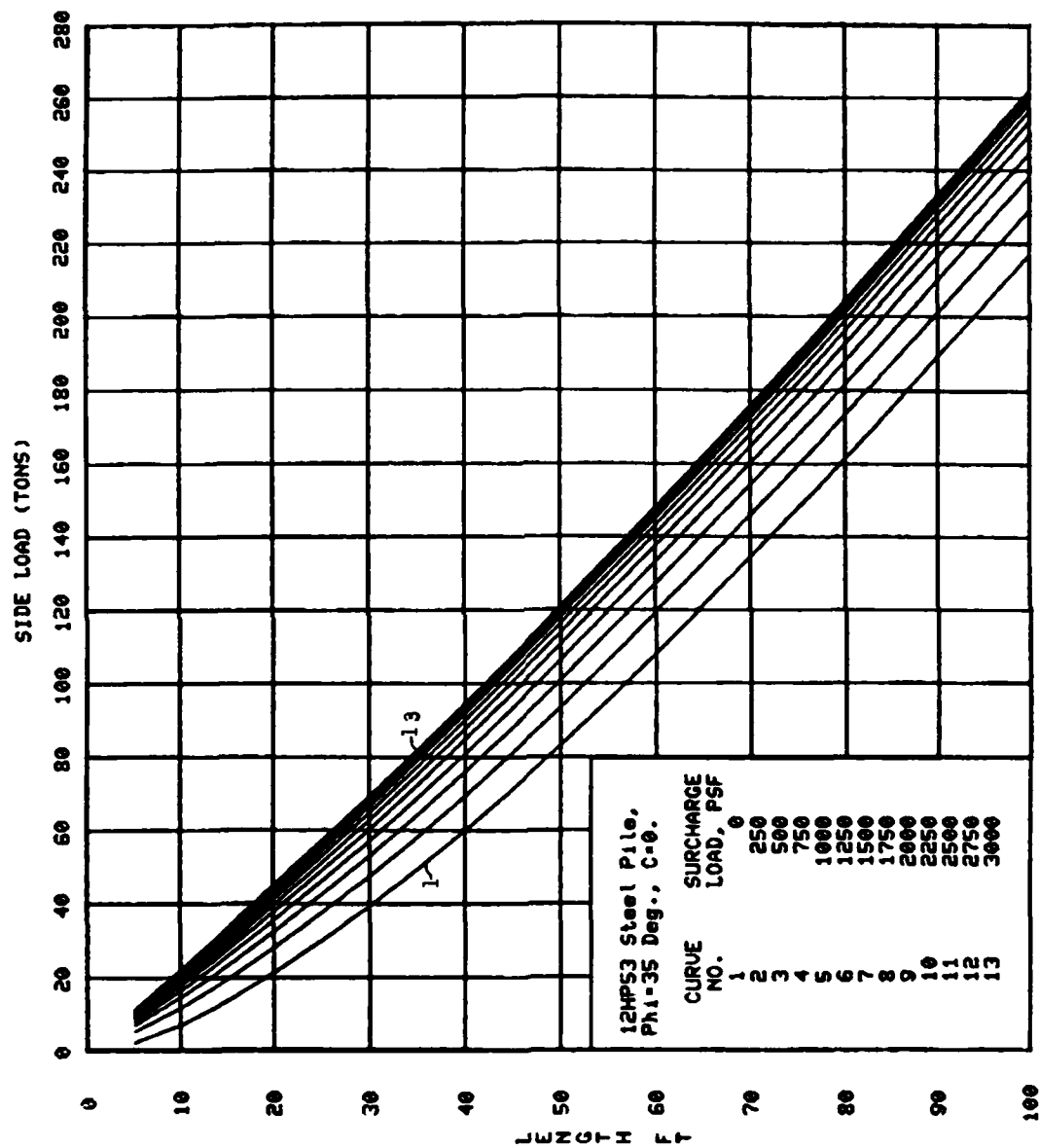


Figure 22. Side Capacity For A 12HP53 Steel Pile,  
Submerged Condition, 1/4-in. Tip Movement, Phi=35 Deg., C=0.



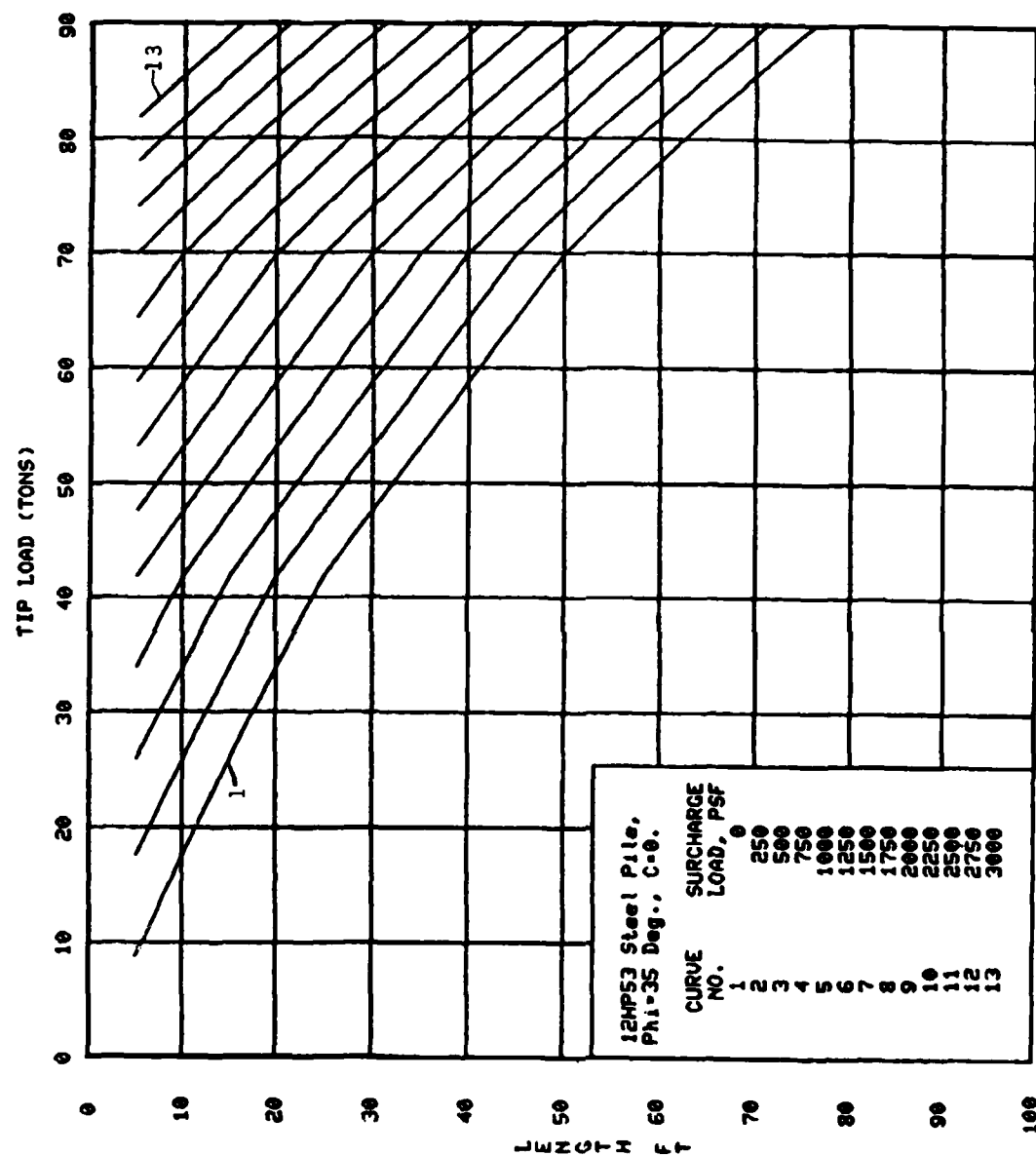


Figure 23. Tip Capacity For A 12HP53 Steel Pile, Submerged Condition, 1/4-in. Tip Movement, Phi=35 Deg., C=0.



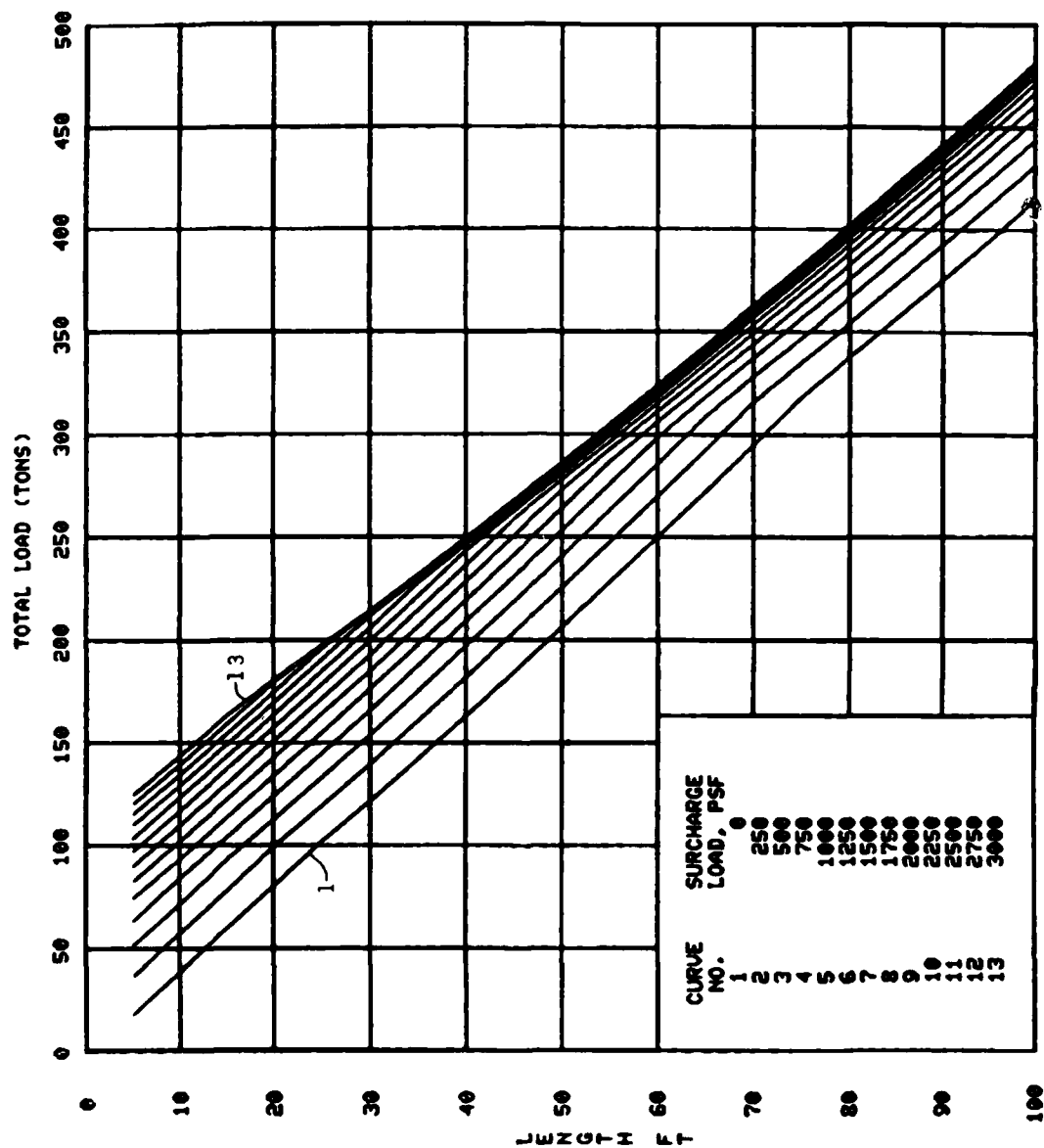


Figure 26. Total Pile Capacity For A 12MP53 Steel Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi=37$  Deg.,  $C=0$ .



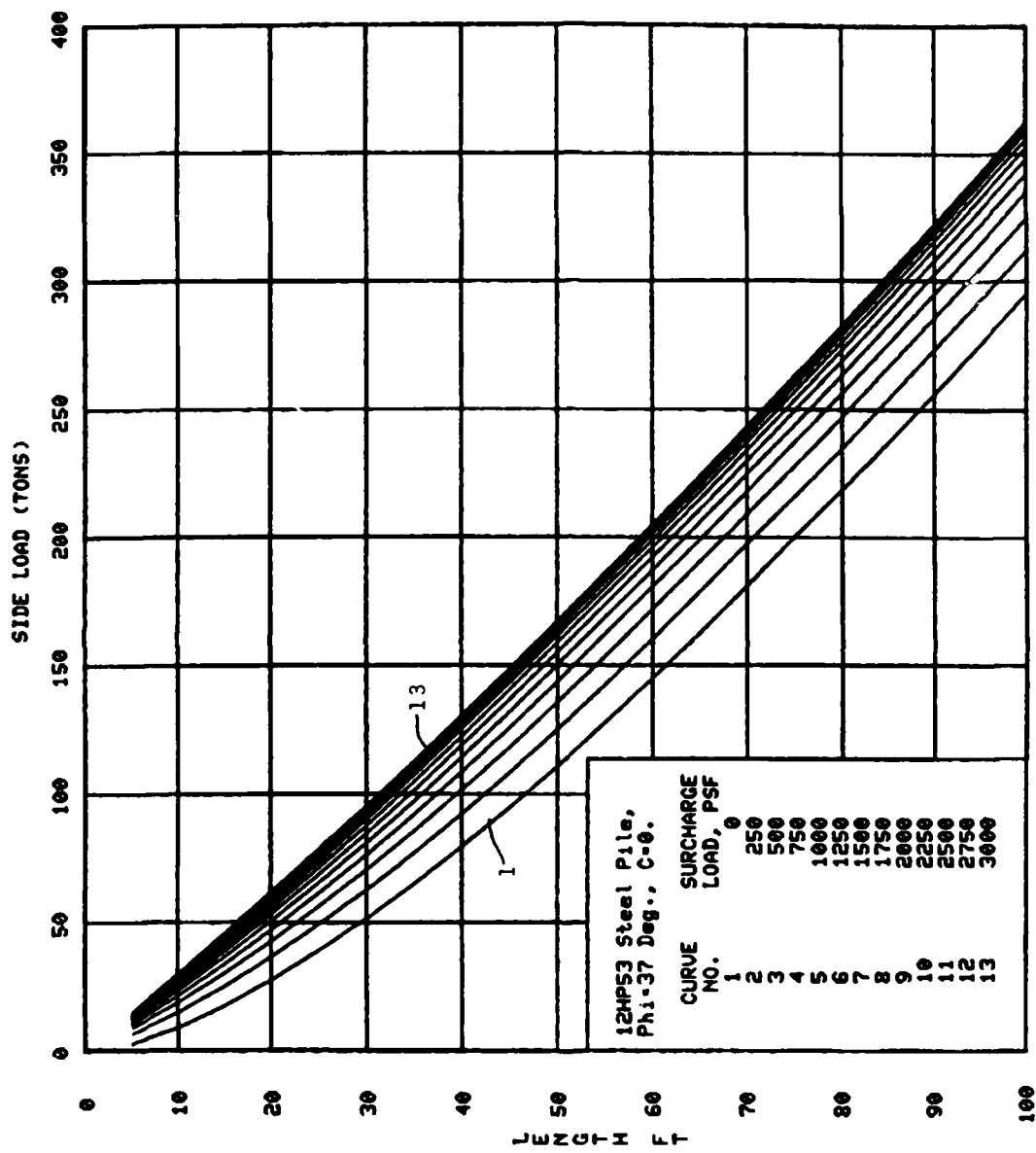


Figure 25. Side Capacity For A 12HP53 Steel Pile,  
Submerged Condition, 1/4-in. Tip Movement, Phi=37 Deg., C=0.



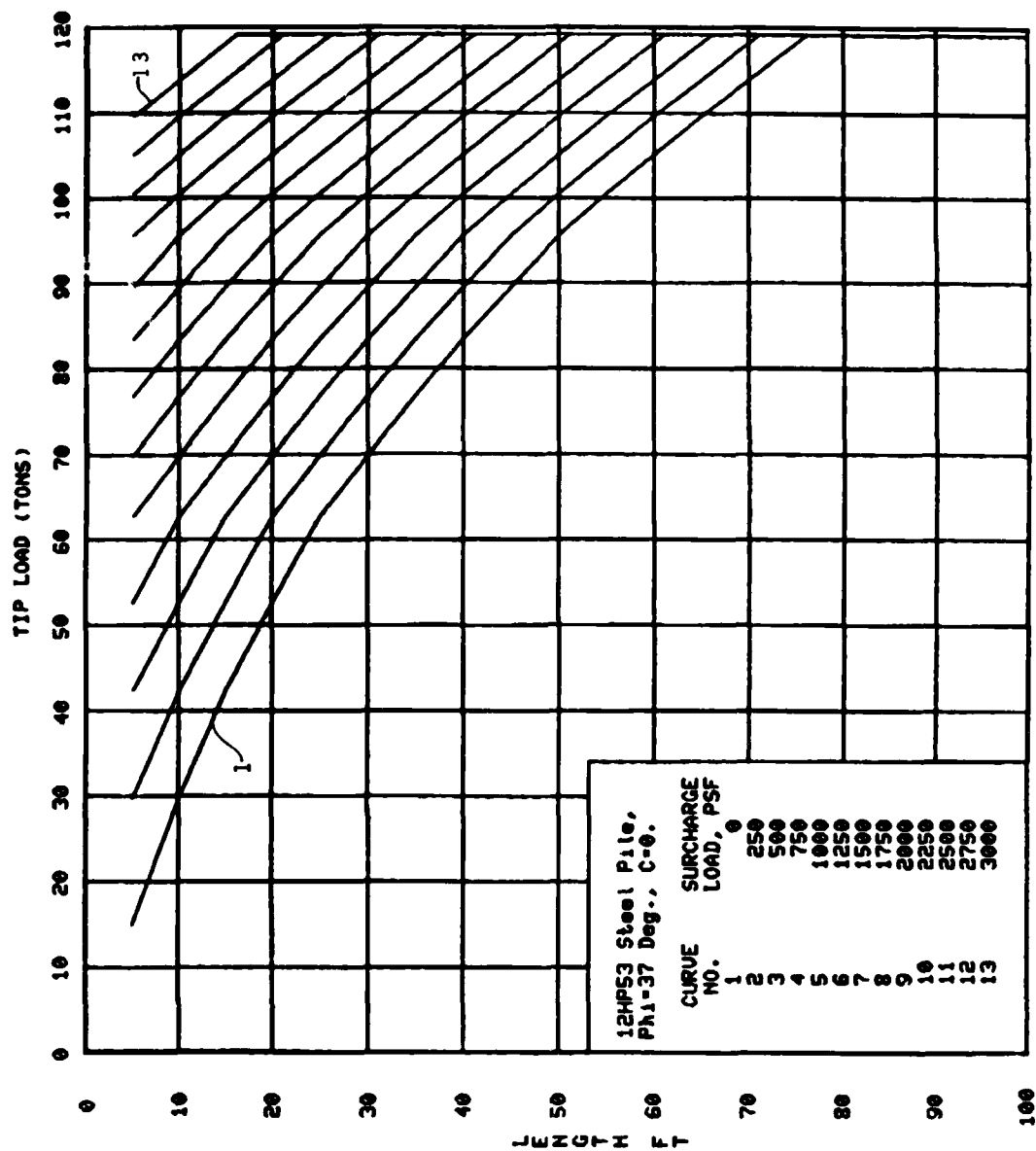


Figure 26. Tip Capacity For A 12HP53 Steel Pile,  
 Submerged Condition,  $1\frac{1}{4}$ -in. Tip Movement,  $\phi_1=37$  Deg.,  $C=0$ .



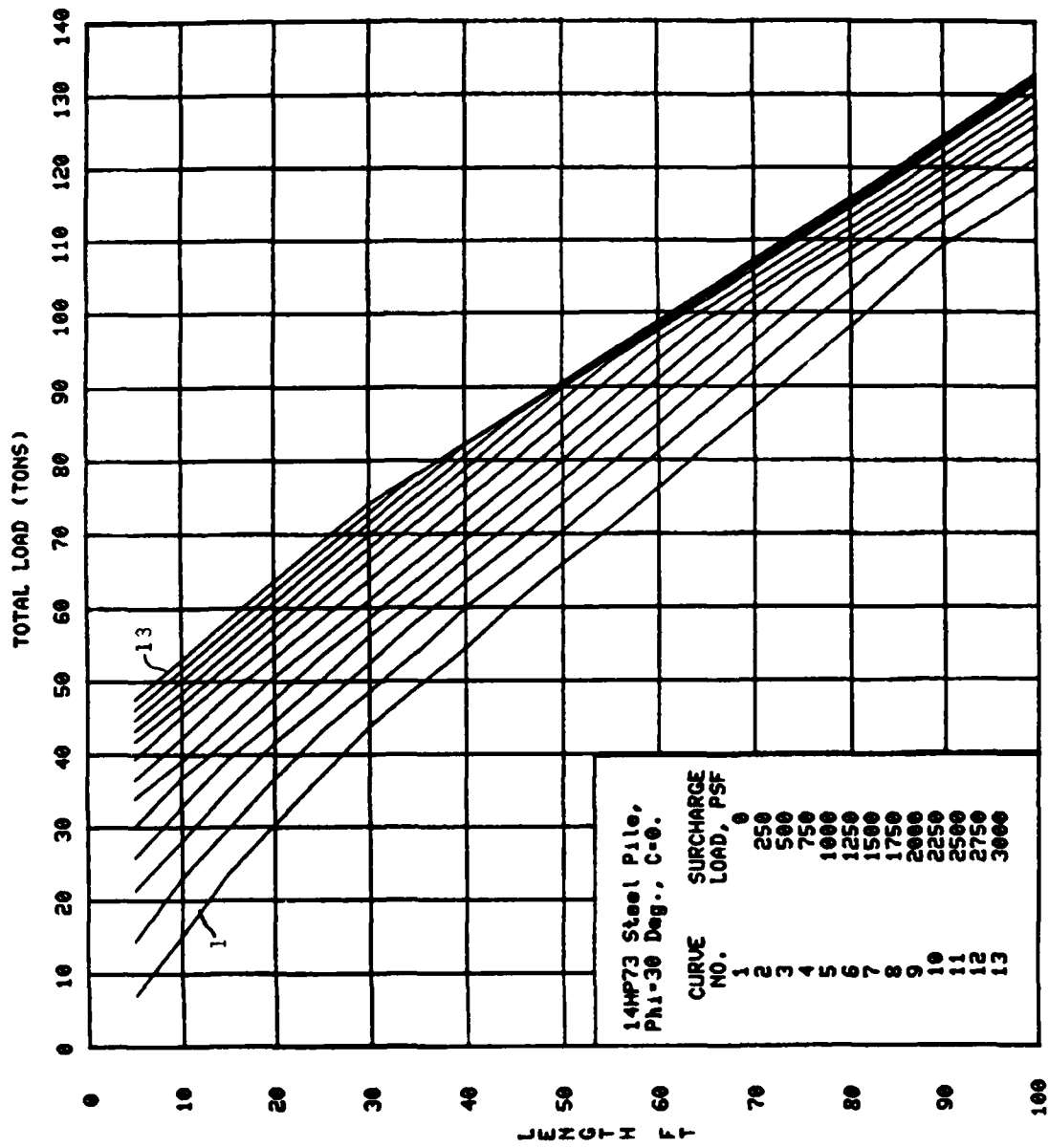


Figure 27. Total Pile Capacity For A 14HP73 Steel Pile,  
Submerged Condition, 1/4-in. Tip Movement, Phi=30 Deg., C=0.



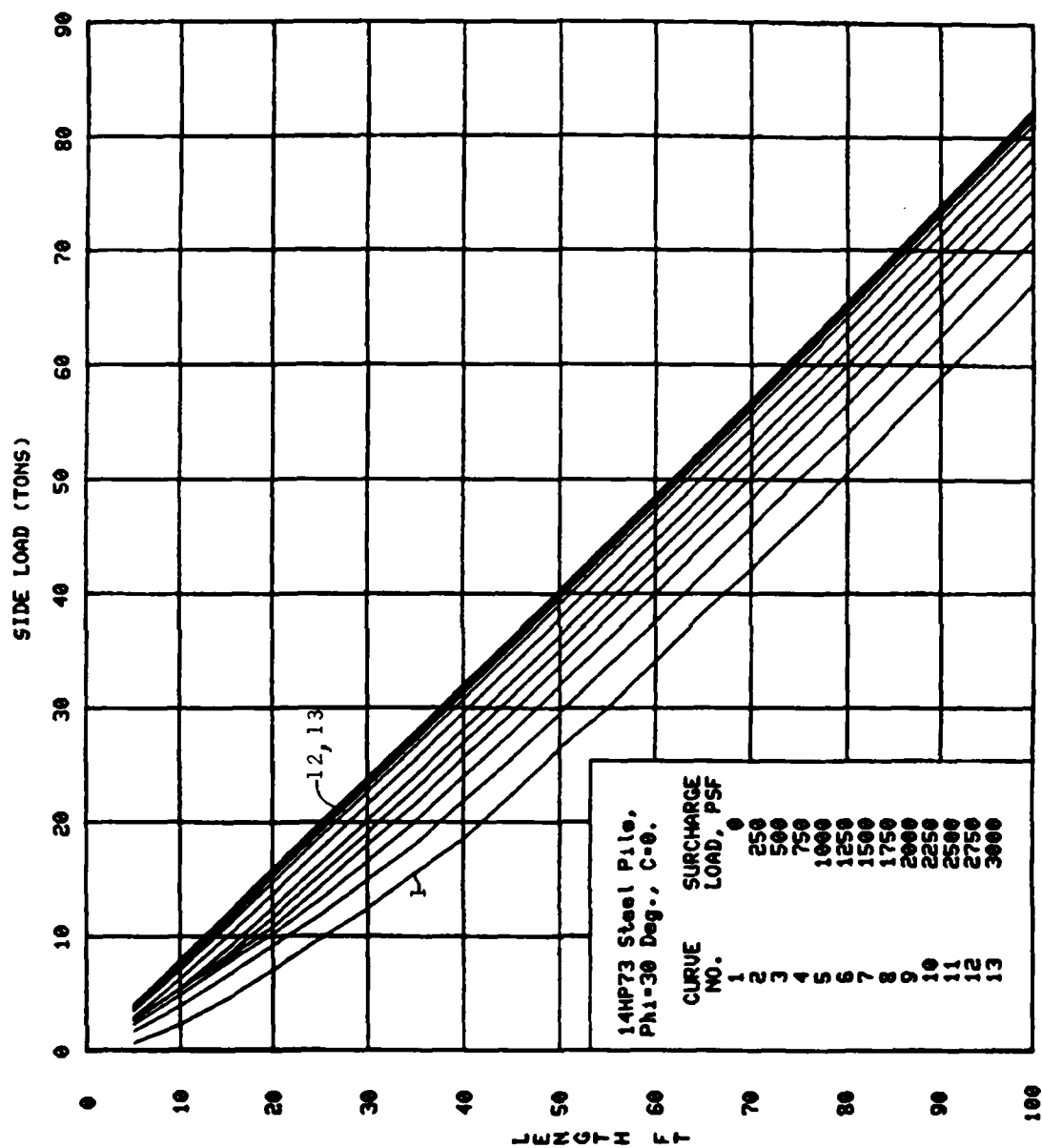


Figure 28. Side Capacity For A 14HP73 Steel Pile, Submerged Condition, 1/4-in. Tip Movement, Phi=30 Deg., C=0.



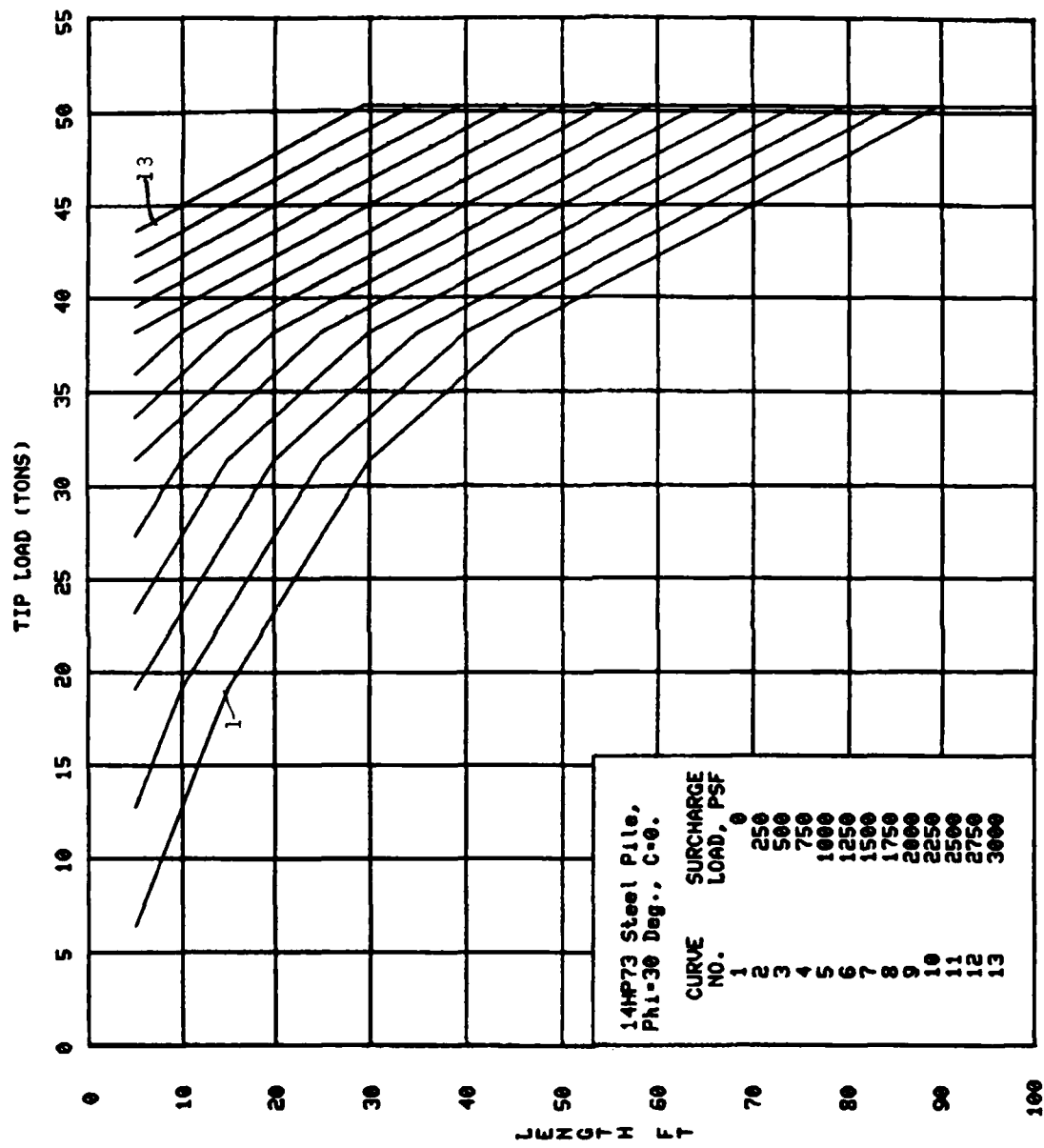


Figure 29 . Tip Capacity For A 14HP73 Steel Pile,  
Submerged Condition, 1/4-in. Tip Movement, Phi=30 Deg., C=0.



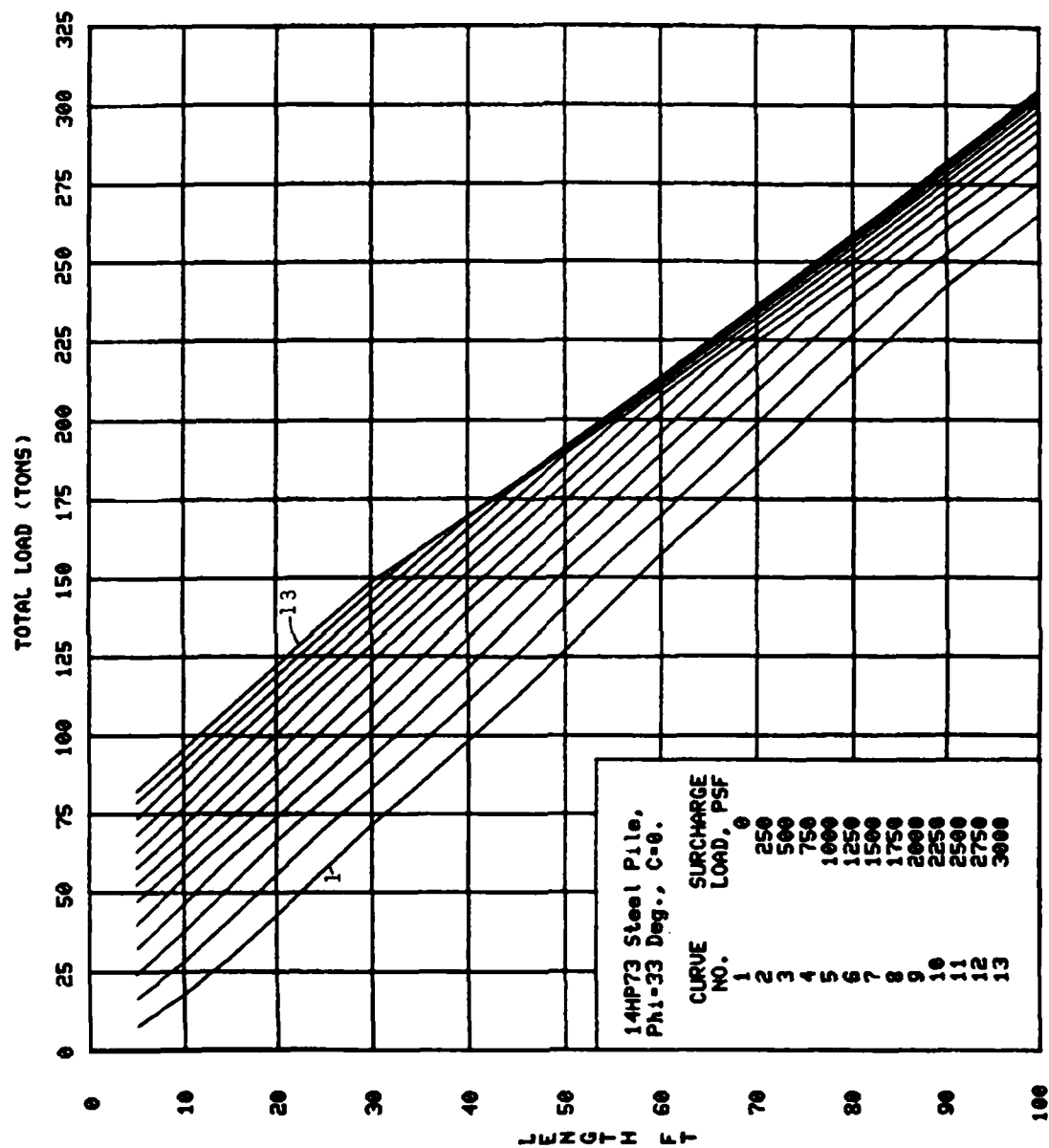


Figure 30. Total Pile Capacity For A 14HP73 Steel Pile,  
Submerged Condition, 1/4-in. Tip Movement, Phi-33 Deg., C=0.



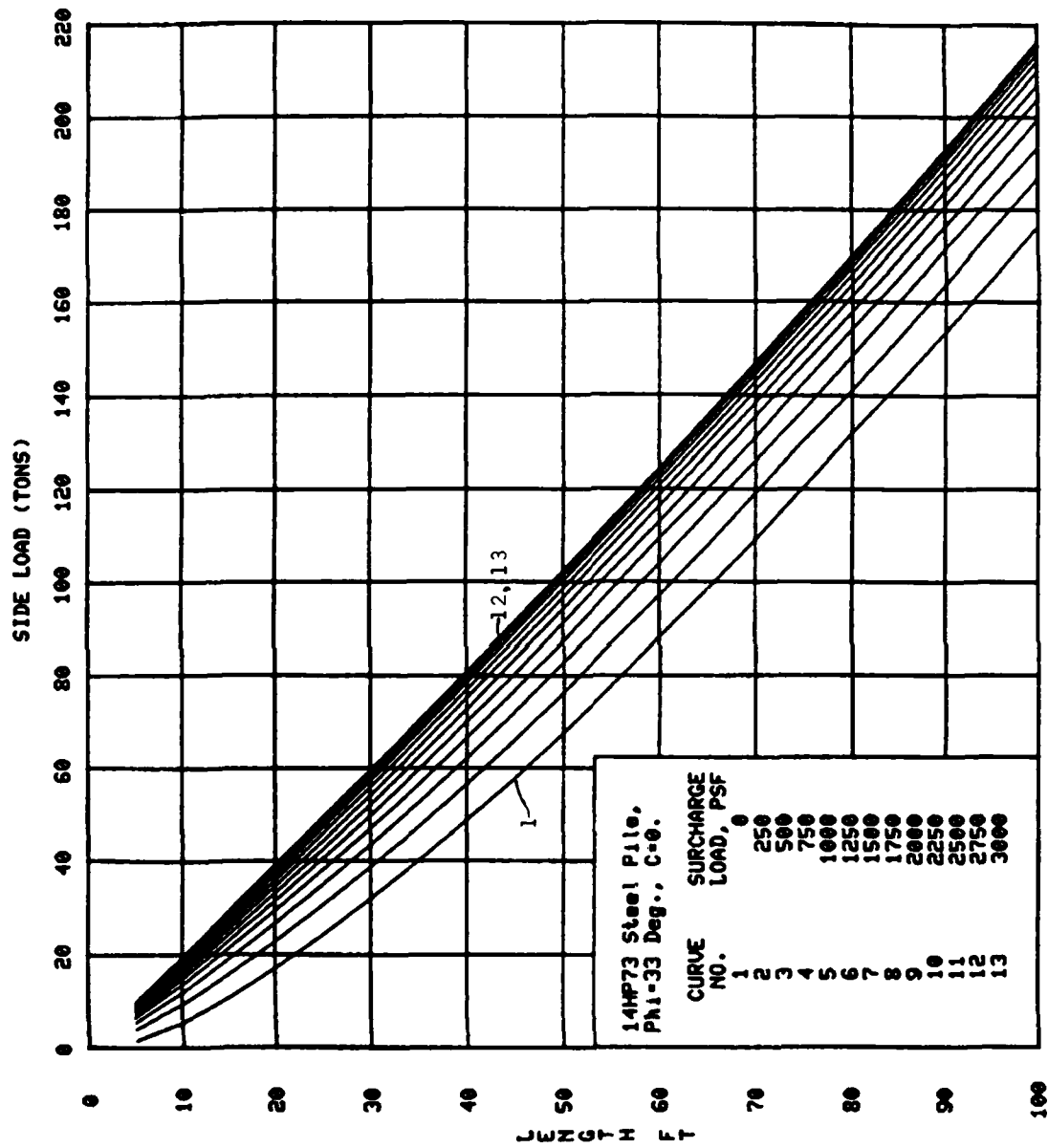


Figure 31. Side Capacity For A 14HP73 Steel Pile,  
Submerged Condition, 1/4-in. Tip Movement, Phi-33 Deg., C=0.



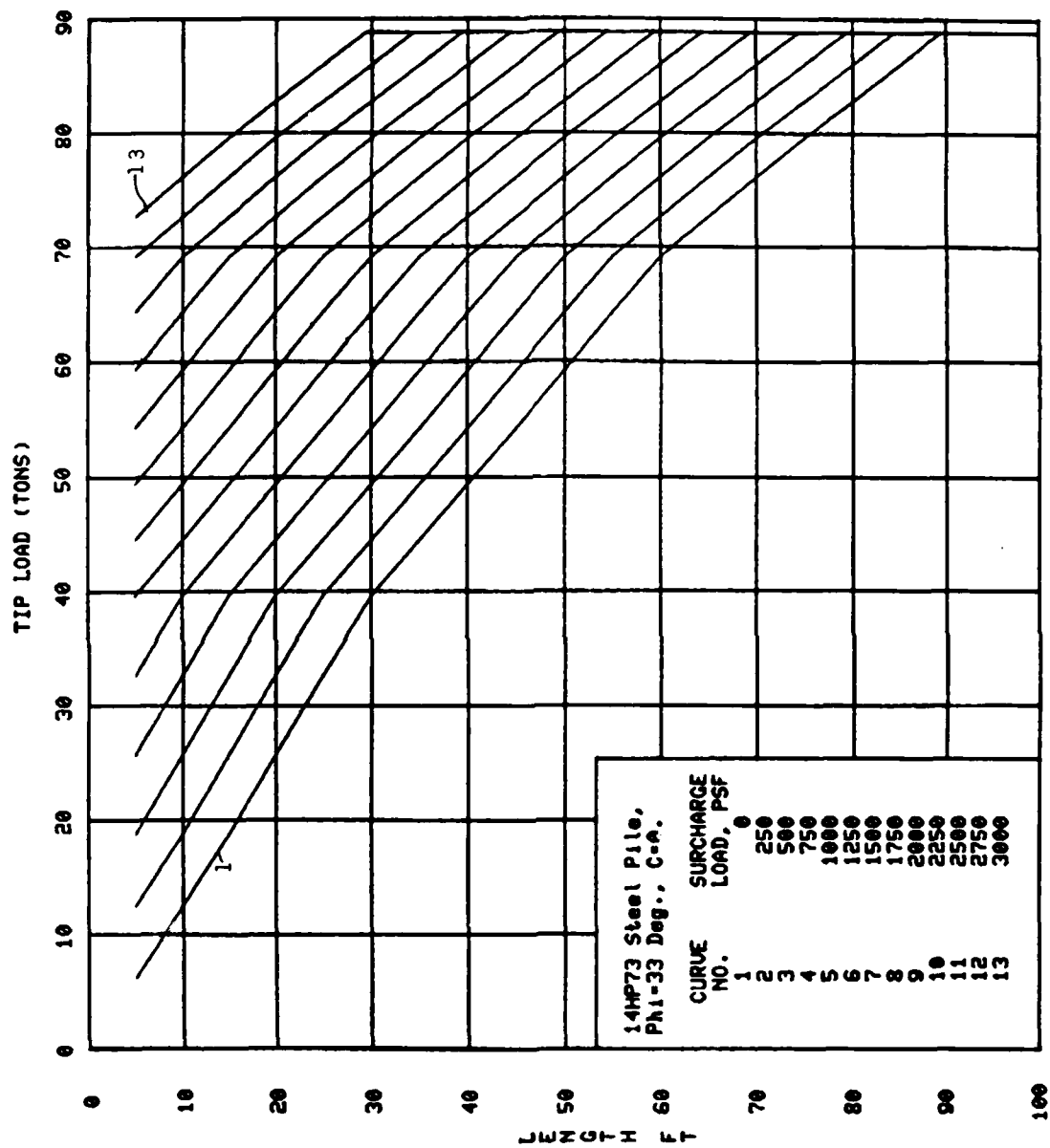


Figure 32. Tip Capacity For A 14HP73 Steel Pile,  
Submerged Condition, 1/4-in. Tip Movement, Phi=33 Deg., C=0.



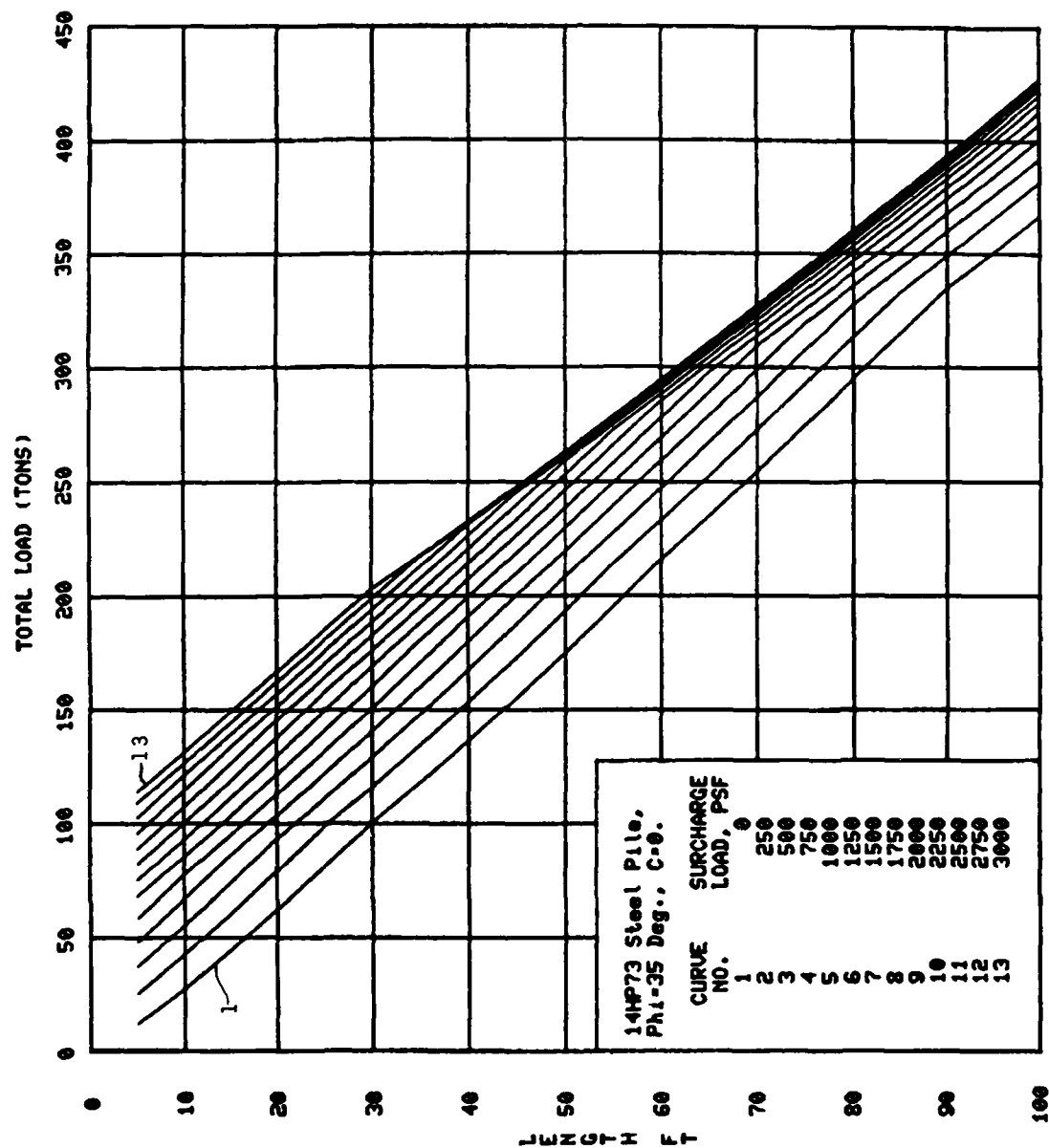


Figure 33. Total Pile Capacity For A 14HP73 Steel Pile,  
Submerged Condition, 1/4-in. Tip Movement, Phi=35 Deg., C=0.



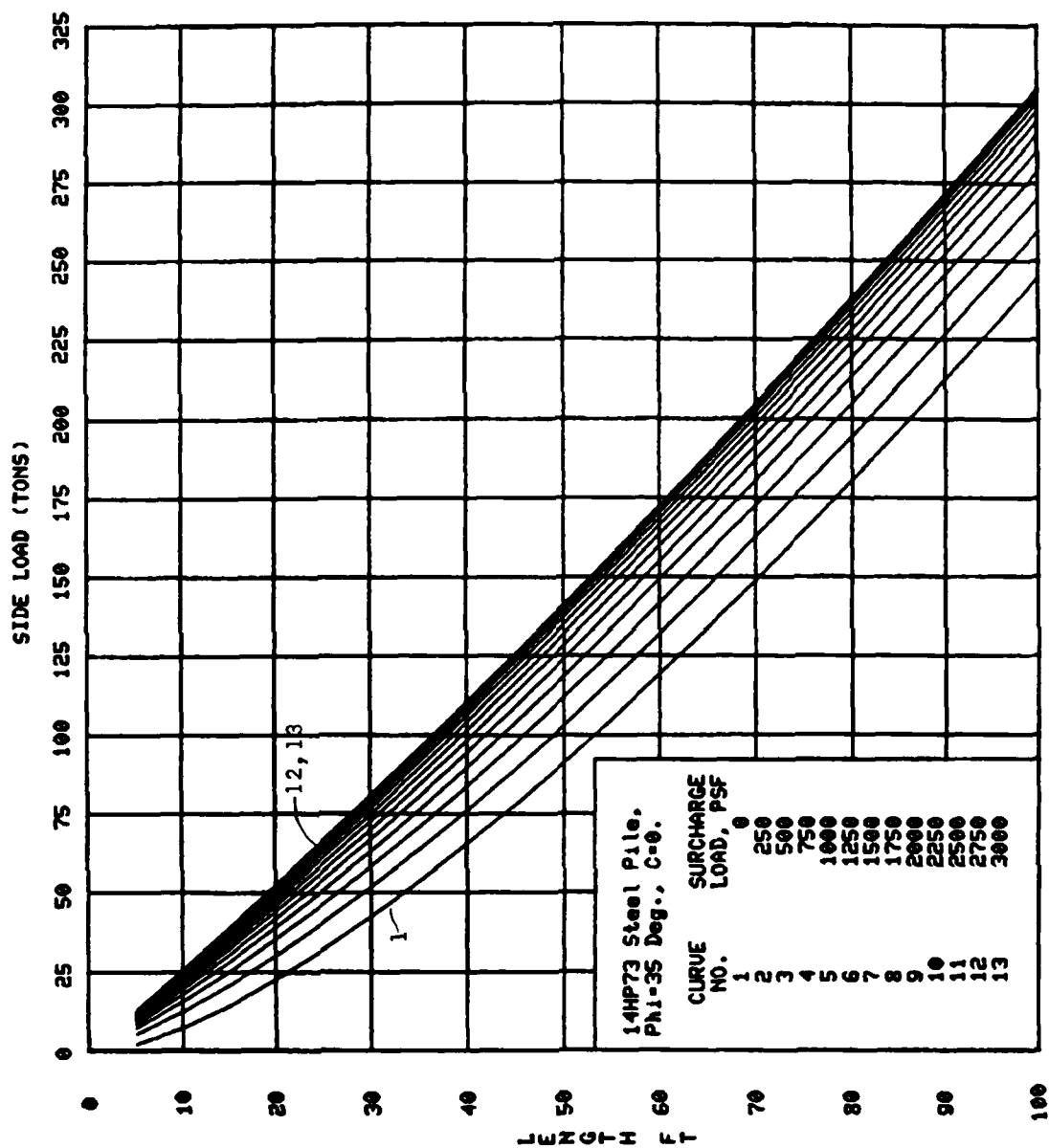


Figure 34. Side Capacity For A 14HP73 Steel Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi=35$  Deg.,  $C=0$ .



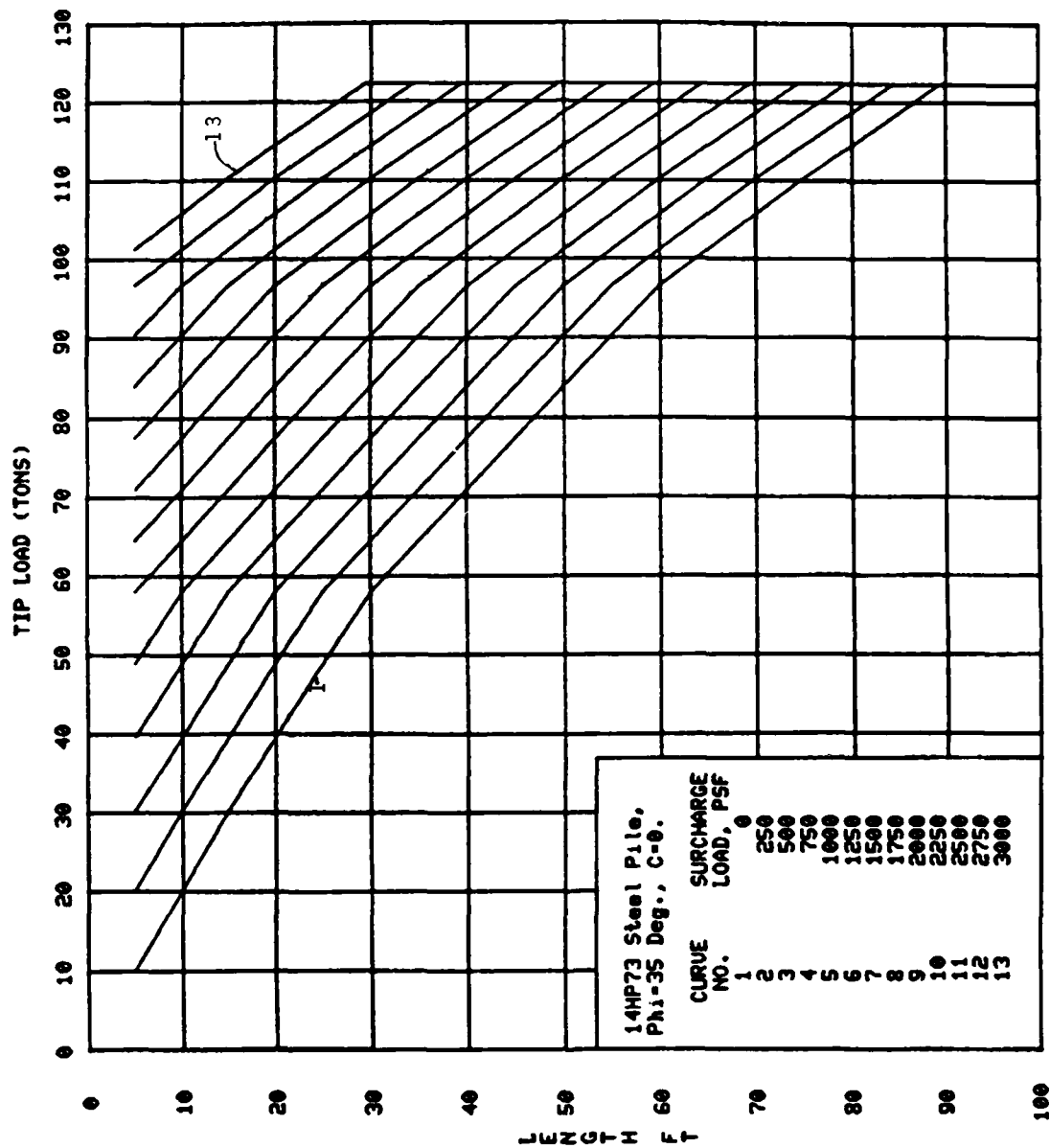


Figure 35. Tip Capacity For A 14HP73 Steel Pile,  
Submerged Condition, 1/4-in. Tip Movement, Phi-35 Deg., C=0.



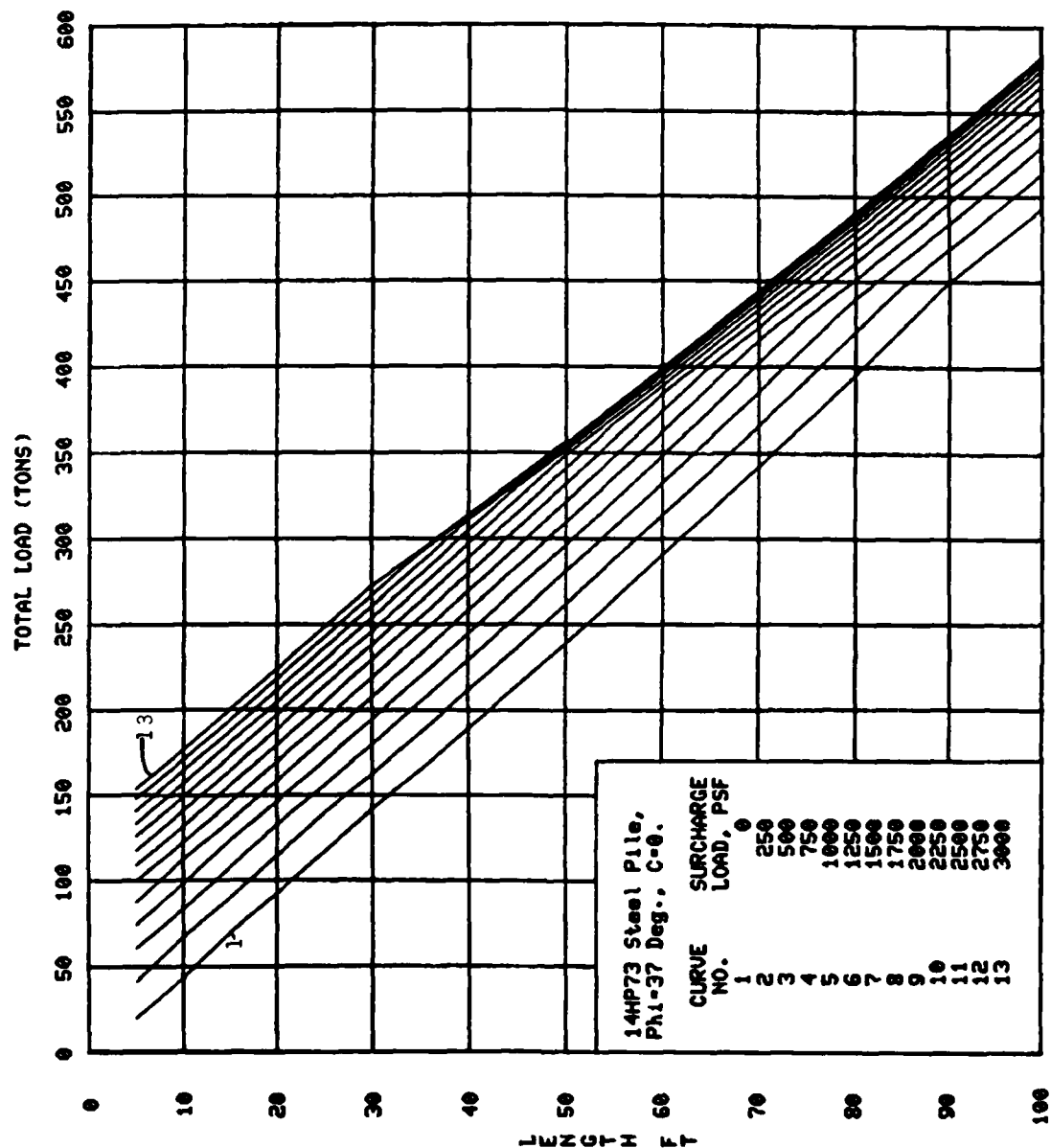


Figure 36. Total Pile Capacity For A 14HP73 Steel Pile,  
Submerged Condition, 1/4-in. Tip Movement, Phi-37 Deg., C-0.



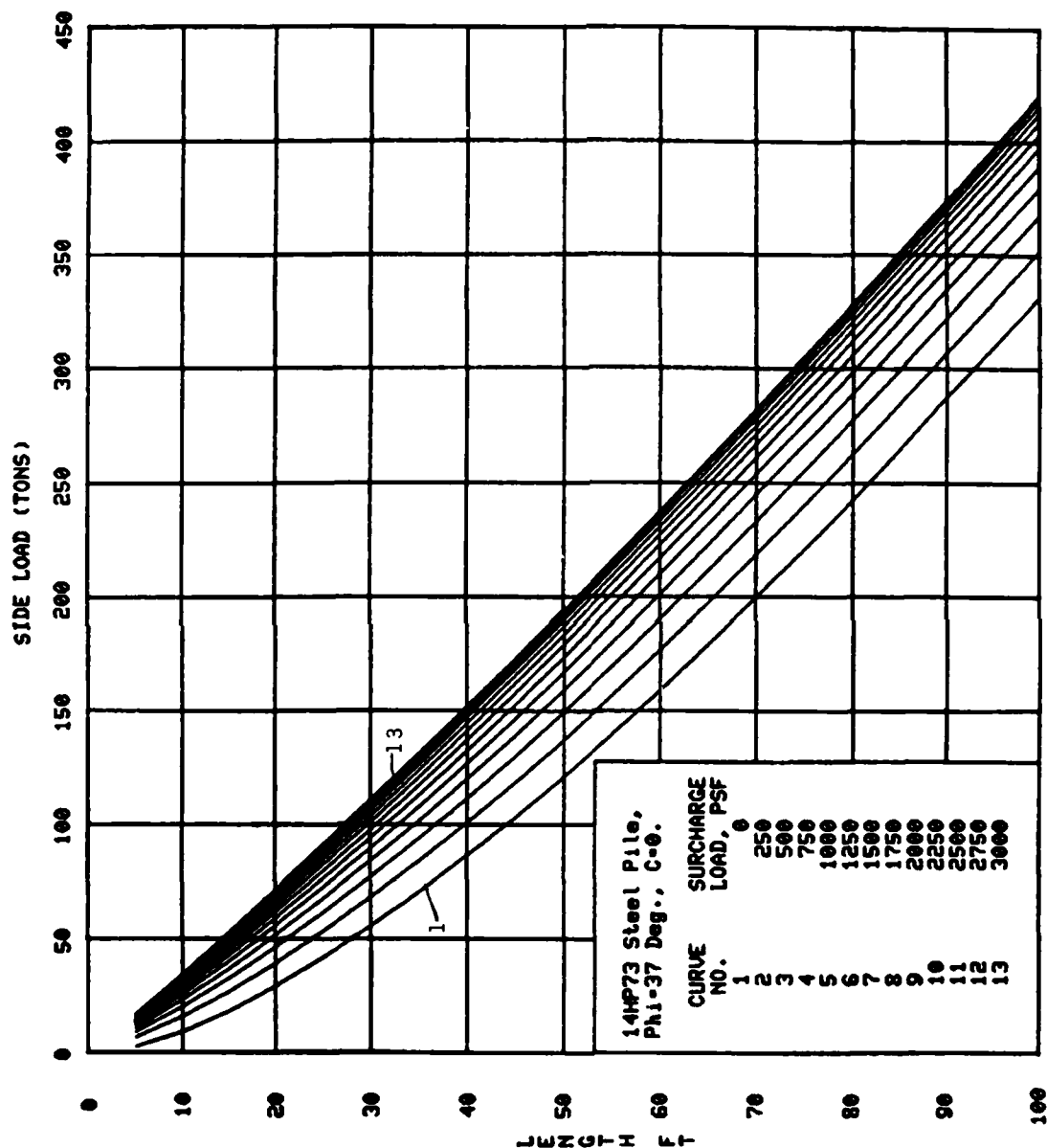


Figure 37. Side Capacity For A 14HP73 Steel Pile,  
Submerged Condition, 1/4-in. Tip Movement, Phi-37 Deg., C-0.



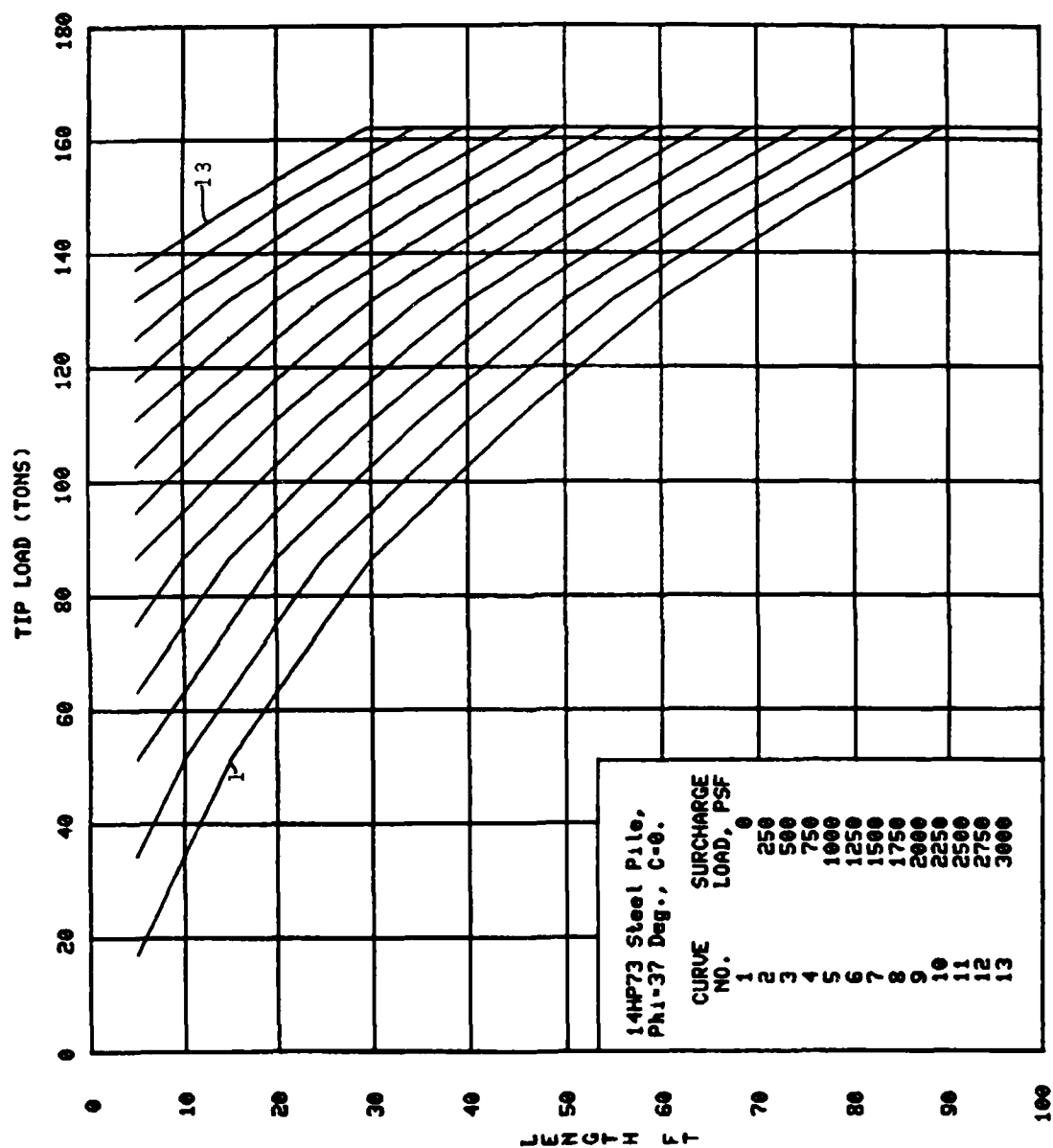


Figure 38. Tip Capacity For A 14HP73 Steel Pile,  
Submerged Condition, 1/4-in. Tip Movement, Phi-37 Deg., C-0.



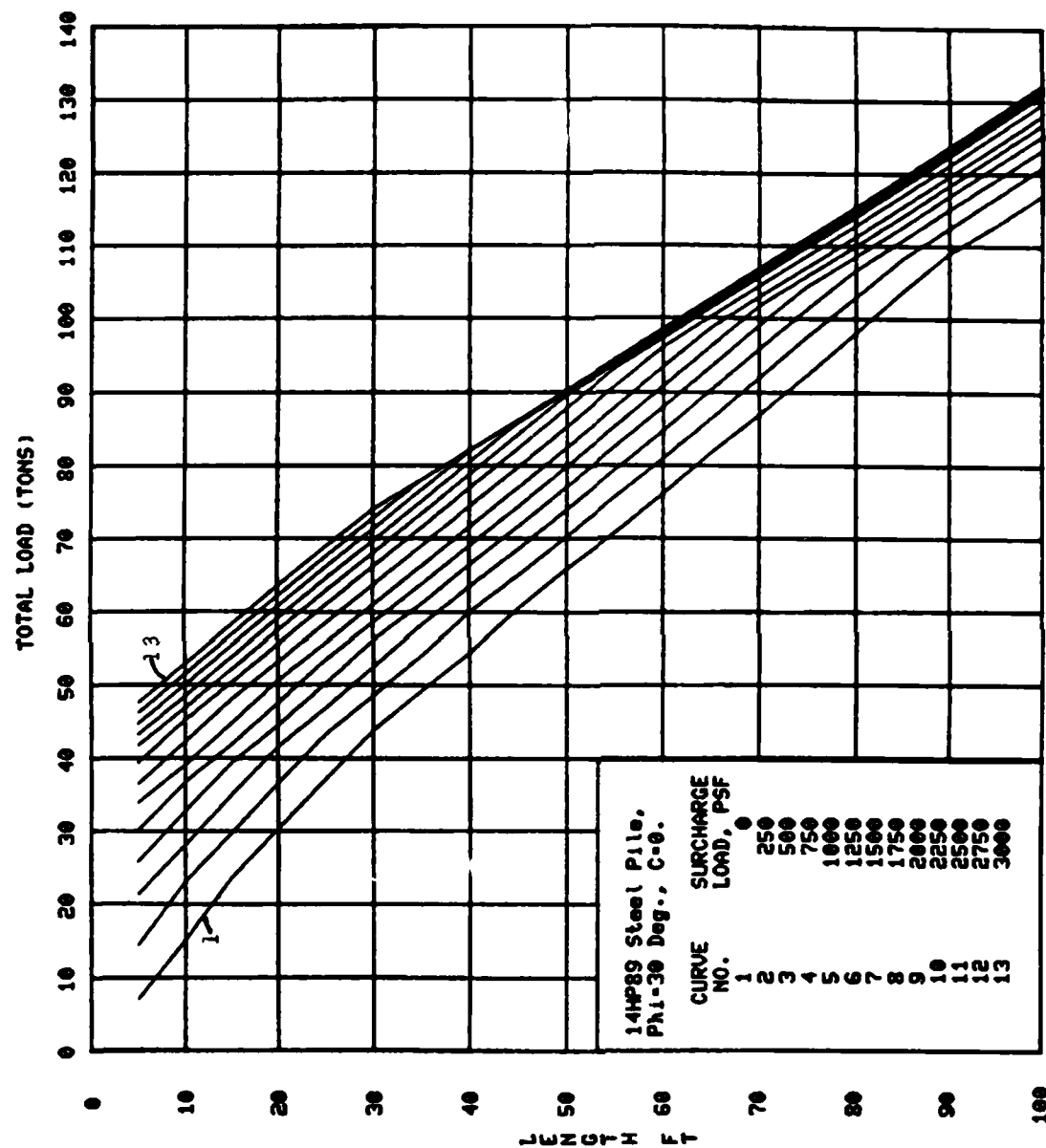


Figure 39. Total Pile Capacity For A 14HP89 Steel Pile, Submerged Condition, 1/4-in. Tip Movement, Phi=30 Deg., C=0.



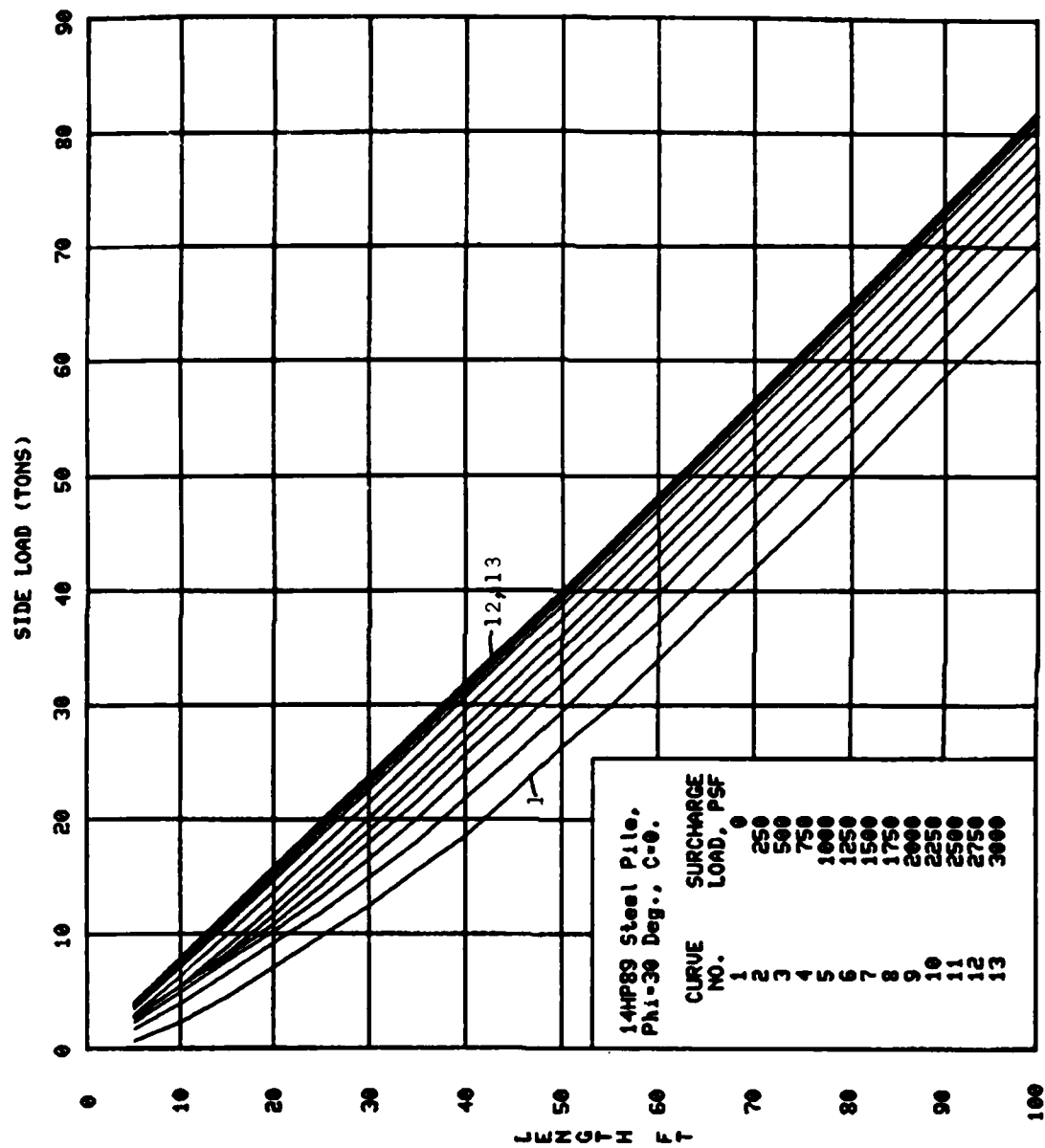


Figure 40. Side Capacity For A 14HP89 Steel Pile,  
Submerged Condition, 1/4-in. Tip Movement, Phi=30 Deg., C=0.



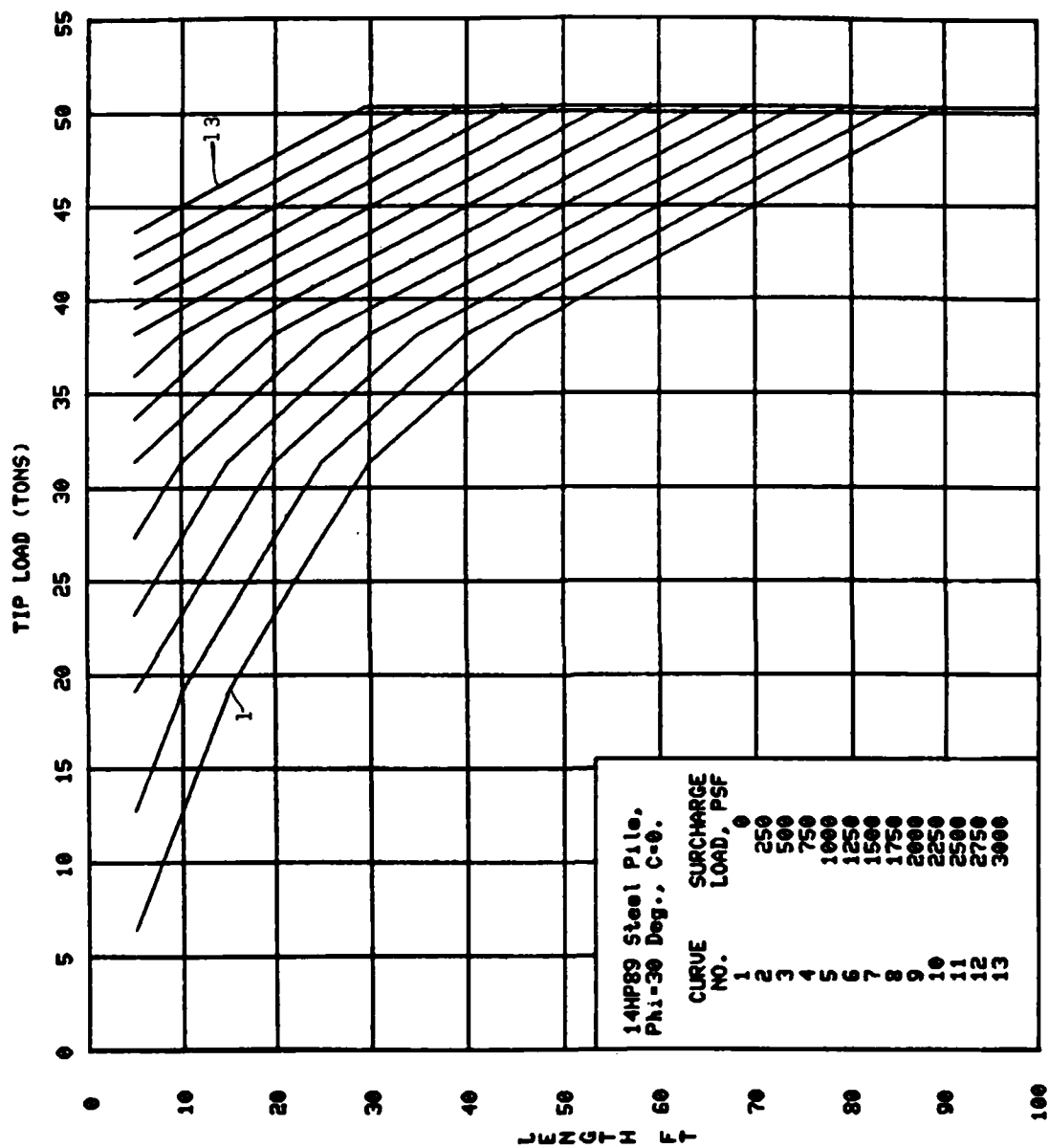


Figure 41. Tip Capacity For A 14HP89 Steel Pile,  
Submerged Condition, 1/4-in. Tip Movement, Phi=30 Deg., C=0.



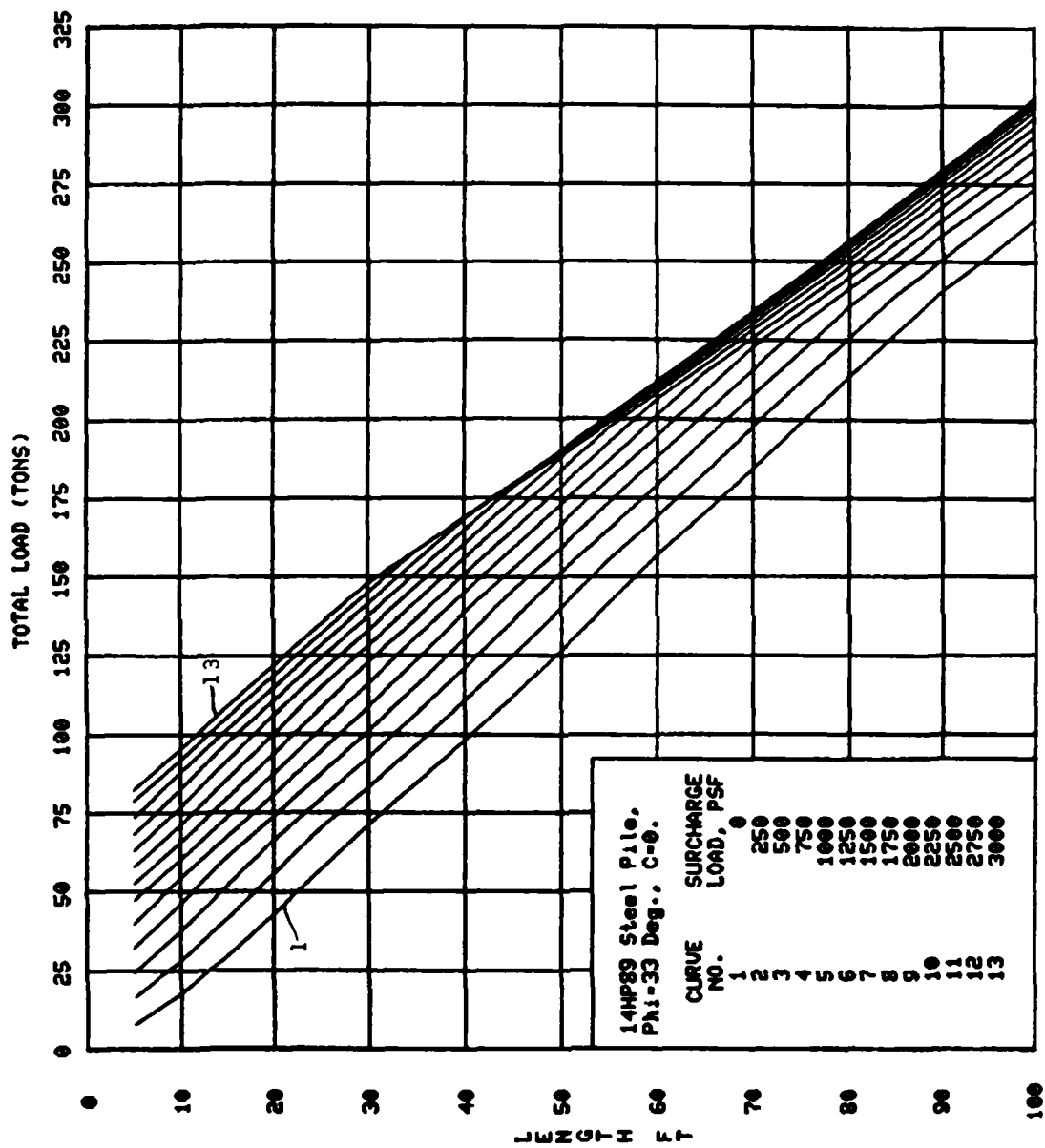


Figure 42. Total Pile Capacity For A 14HP89 Steel Pile,  
Submerged Condition, 1/4-in. Tip Movement, Phi=33 Deg., C=0.



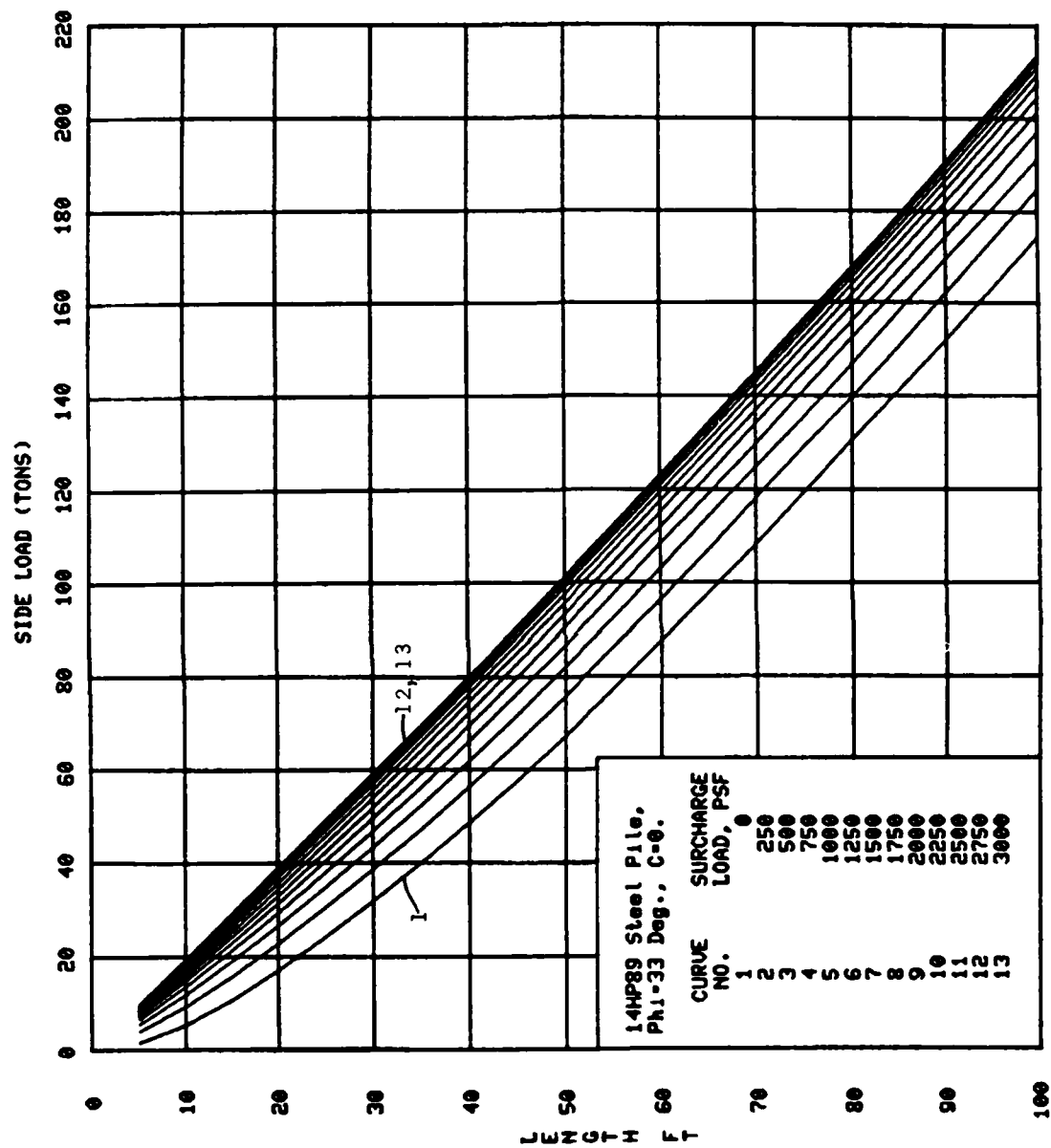


Figure 43. Side Capacity For A 14HP89 Steel Pile,  
Submerged Condition, 1/4-in. Tip Movement, PHI-33 Deg., C-0.



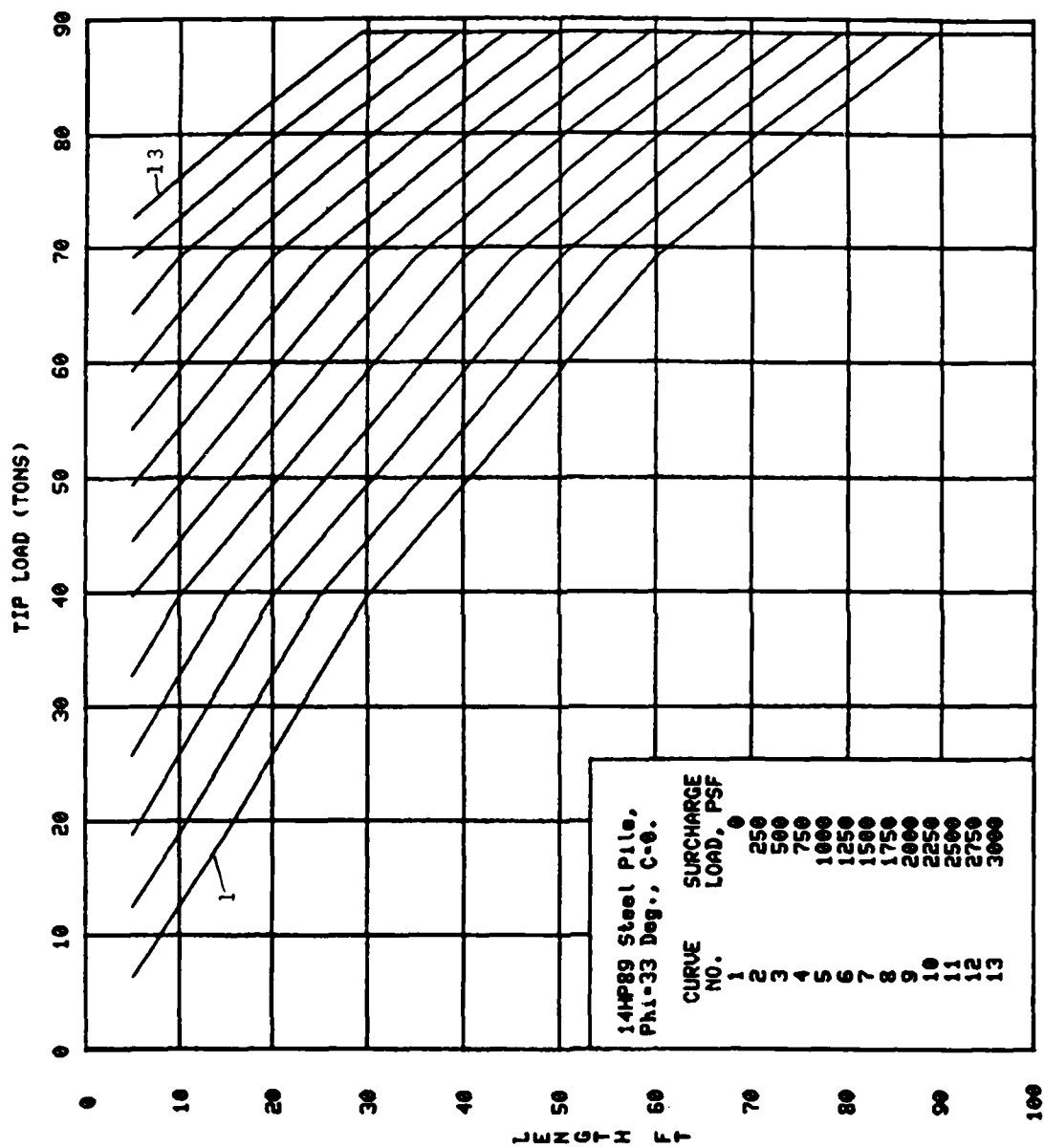


Figure 44. Tip Capacity For A 14HP89 Steel Pile,  
Submerged Condition, 1/4-in. Tip Movement, Phi=33 Deg., C=0.



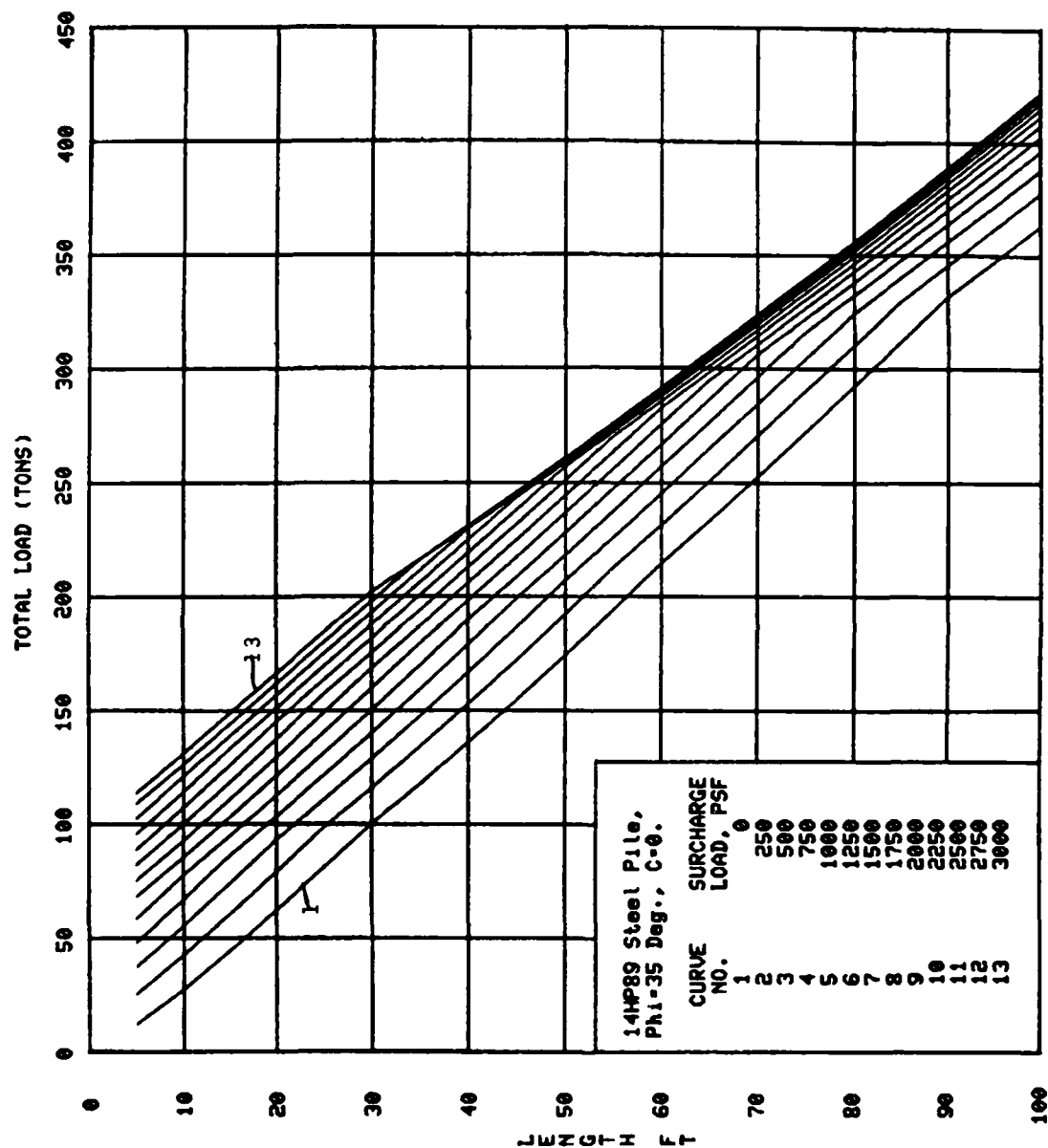


Figure 45. Total Pile Capacity For A 14WP89 Steel Pile, Submerged Condition, 1/4-in. Tip Movement, Phi=35 Deg., C=0.



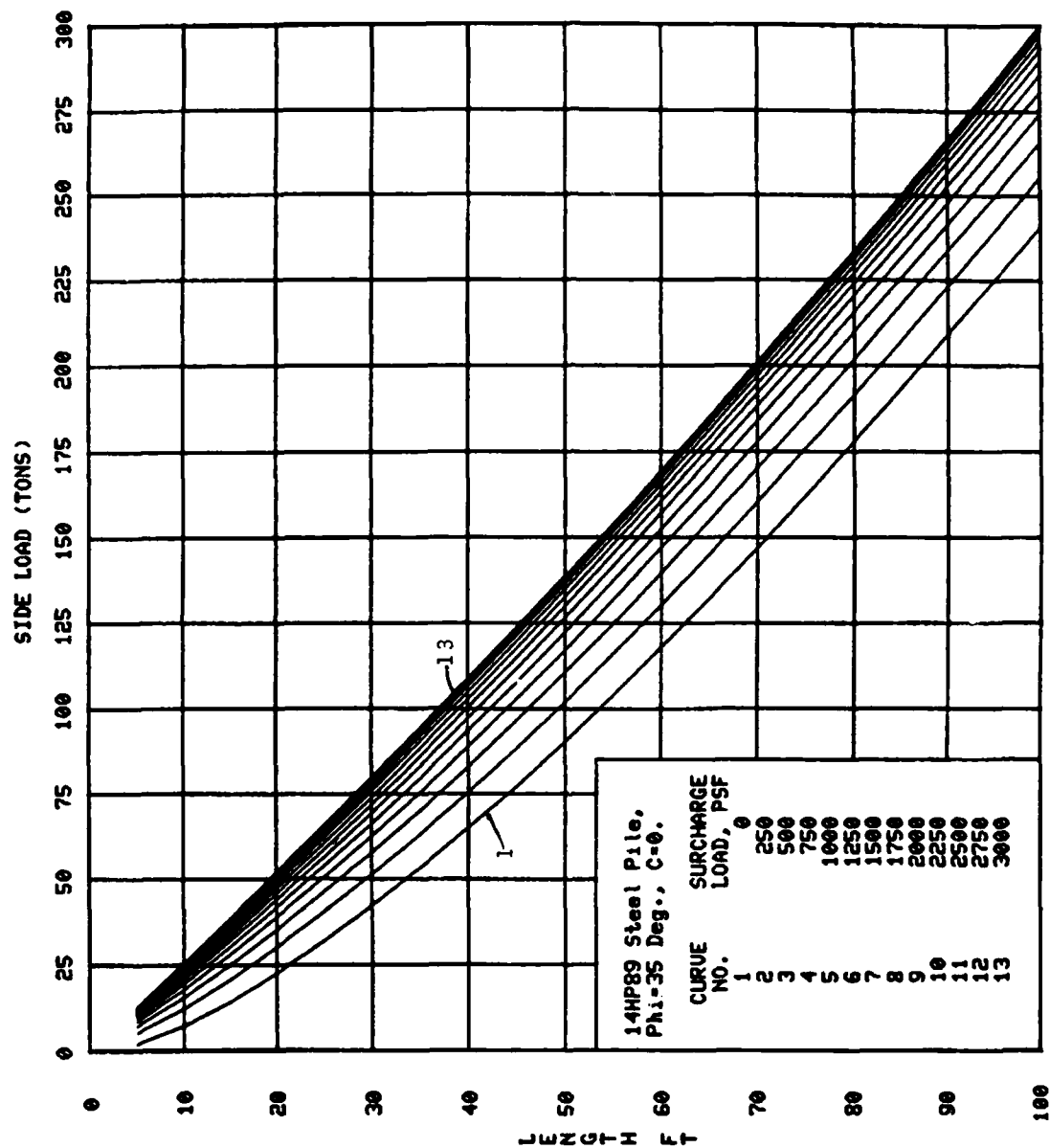


Figure 46. Side Capacity for A 14HP89 Steel Pile,  
 Submerged Condition,  $1/4$ -in. Tip Movement,  $\Phi=35^\circ$  Deg.,  $C=0$ .



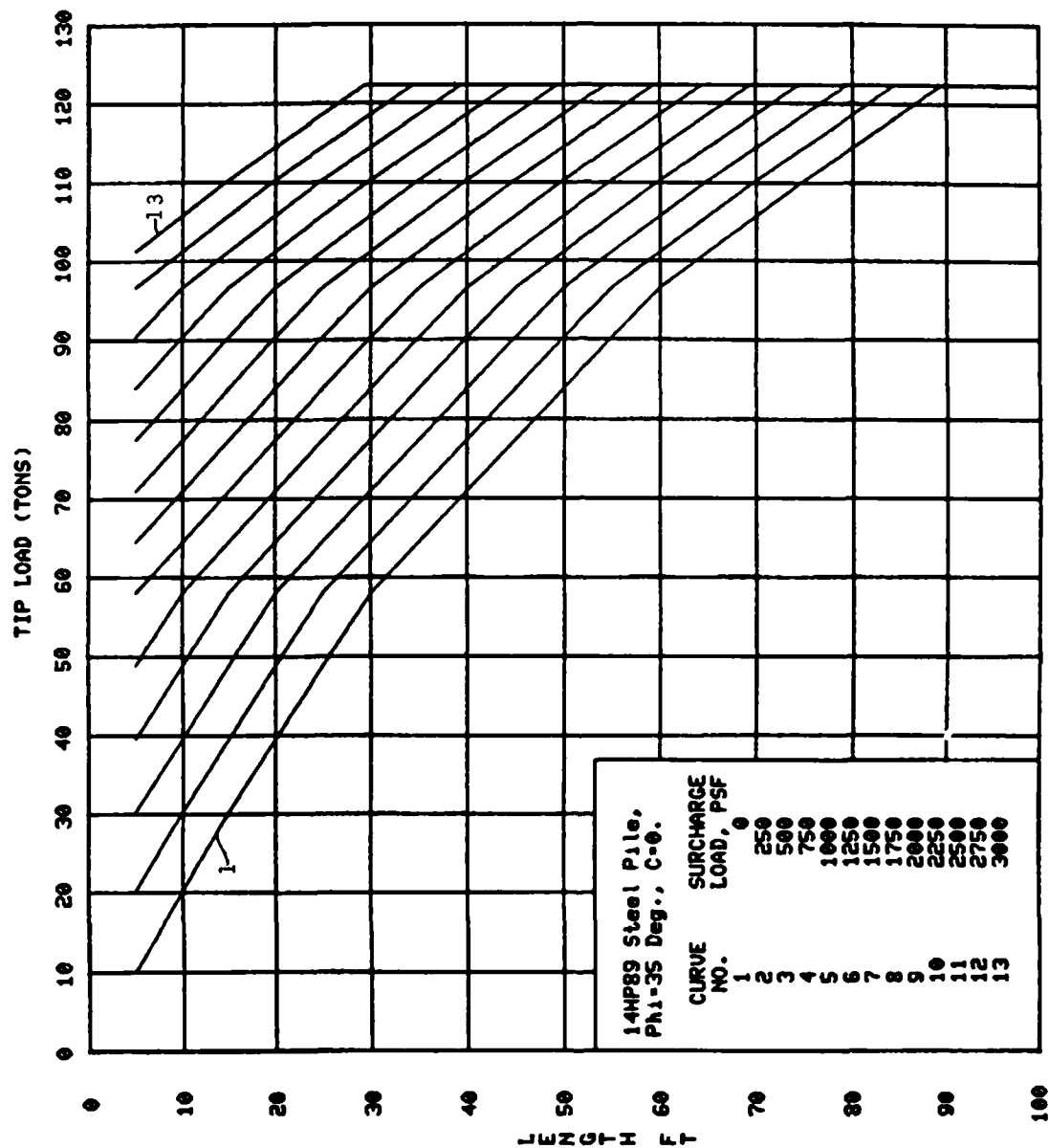


Figure 47. Tip Capacity For A 14HP89 Steel Pile,  
Submerged Condition, 1/4-in. Tip Movement, Phi=35 Deg., C=0.



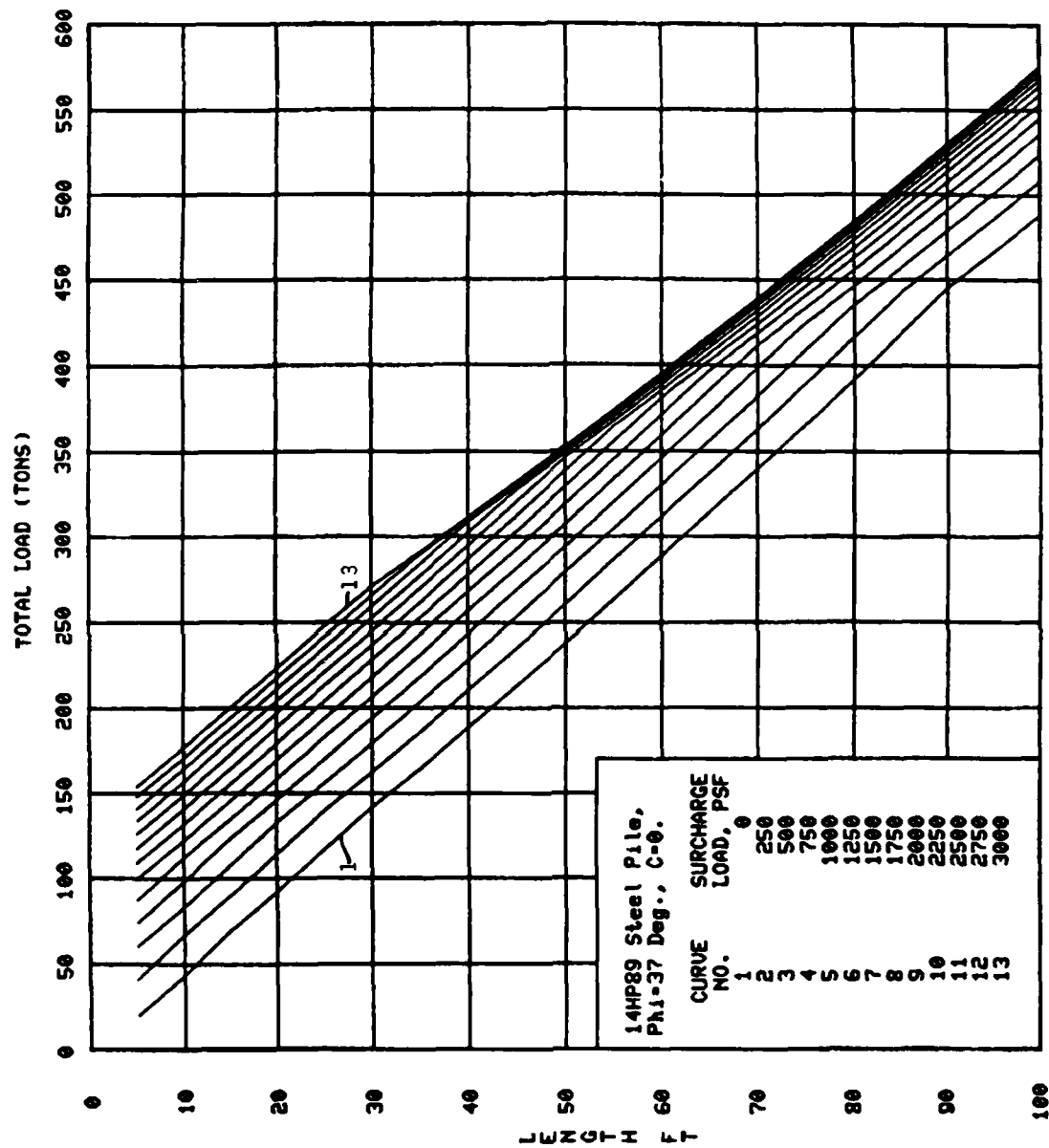


Figure 48. Total Pile Capacity For A 14HP89 Steel Pile,  
Submerged Condition, 1/4-in. Tip Movement, Phi=37 Deg., C=0.



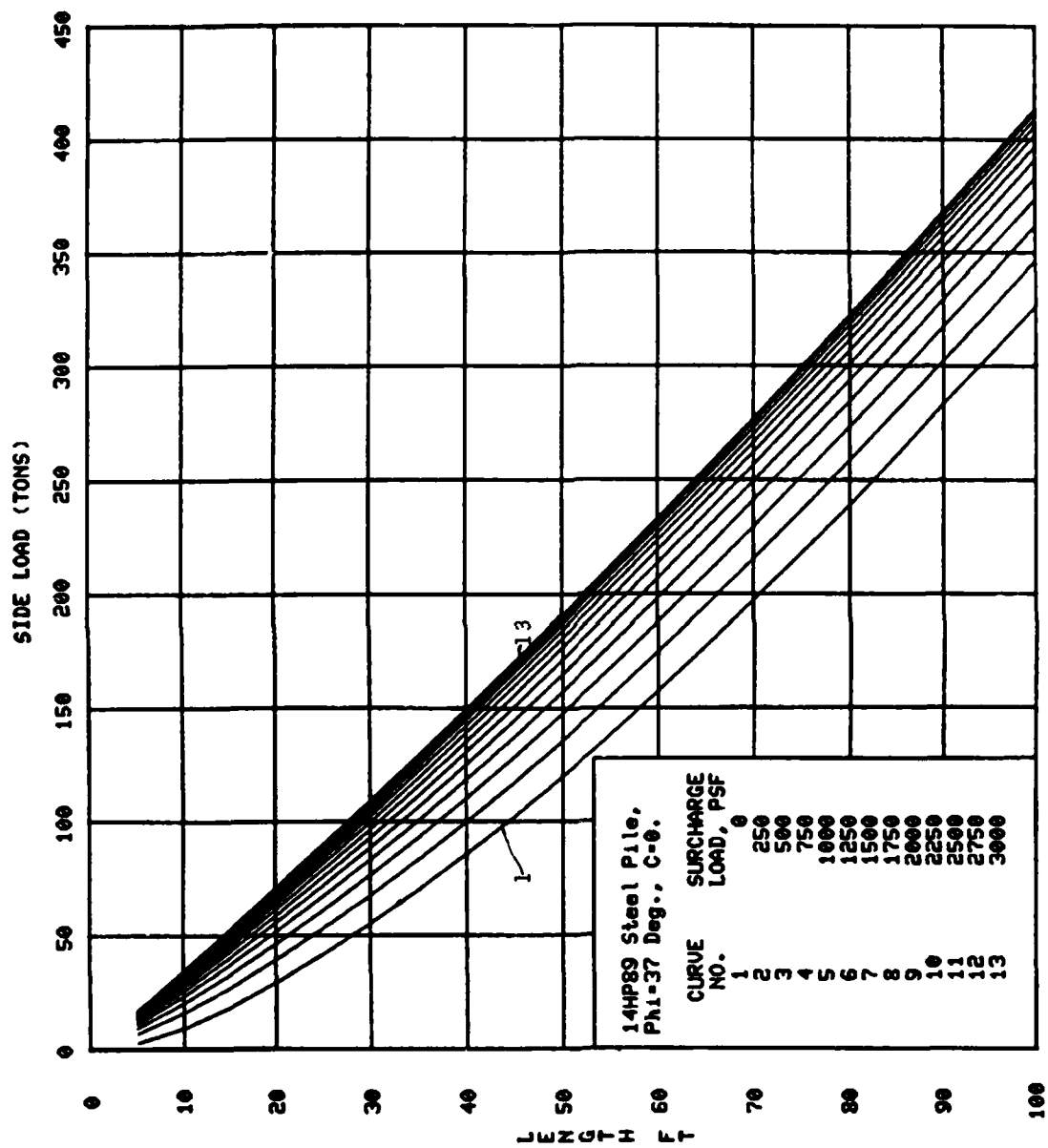


Figure 49. Side Capacity For A 14HP89 Steel Pile,  
Submerged Condition, 1/4-in. Tip Movement, Phi=37 Deg., C=0.



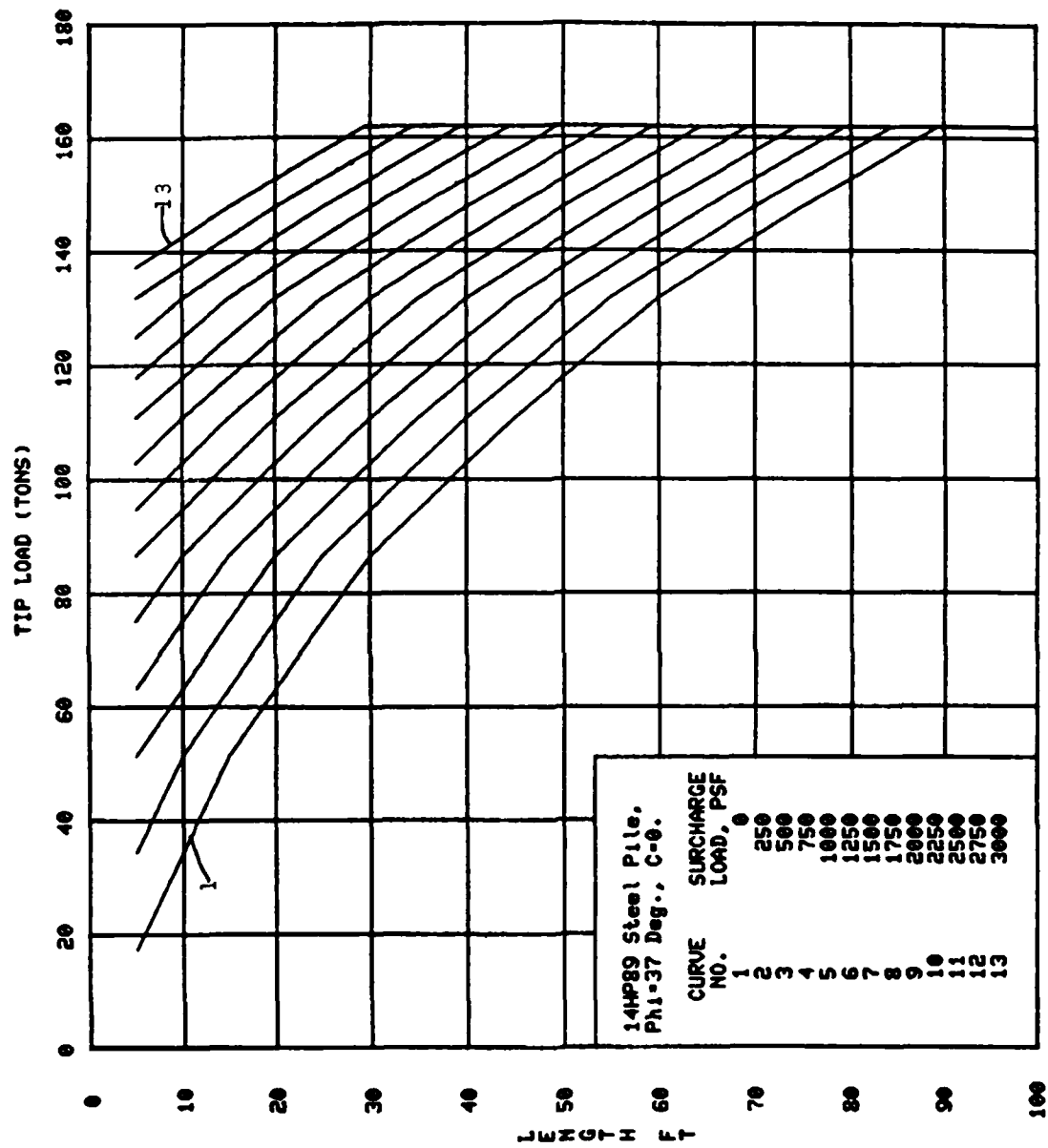


Figure 50. Tip Capacity For A 14HP89 Steel Pile, Submerged Condition, 1/4-in. Tip Movement, Phi=37 Deg., C=0.



### CHAPTER 3: LOAD CAPACITY CURVES FOR STEEL PIPE PILES

Total pile, side, and pit capacity curves for steel pipe piles are presented as follows:

<u>Curves for</u>	<u>Shown in Figure</u>
10 Inches	51-62
12 Inches	63-74
14 Inches	75-86
16 Inches	87-98
20 Inches	99-110



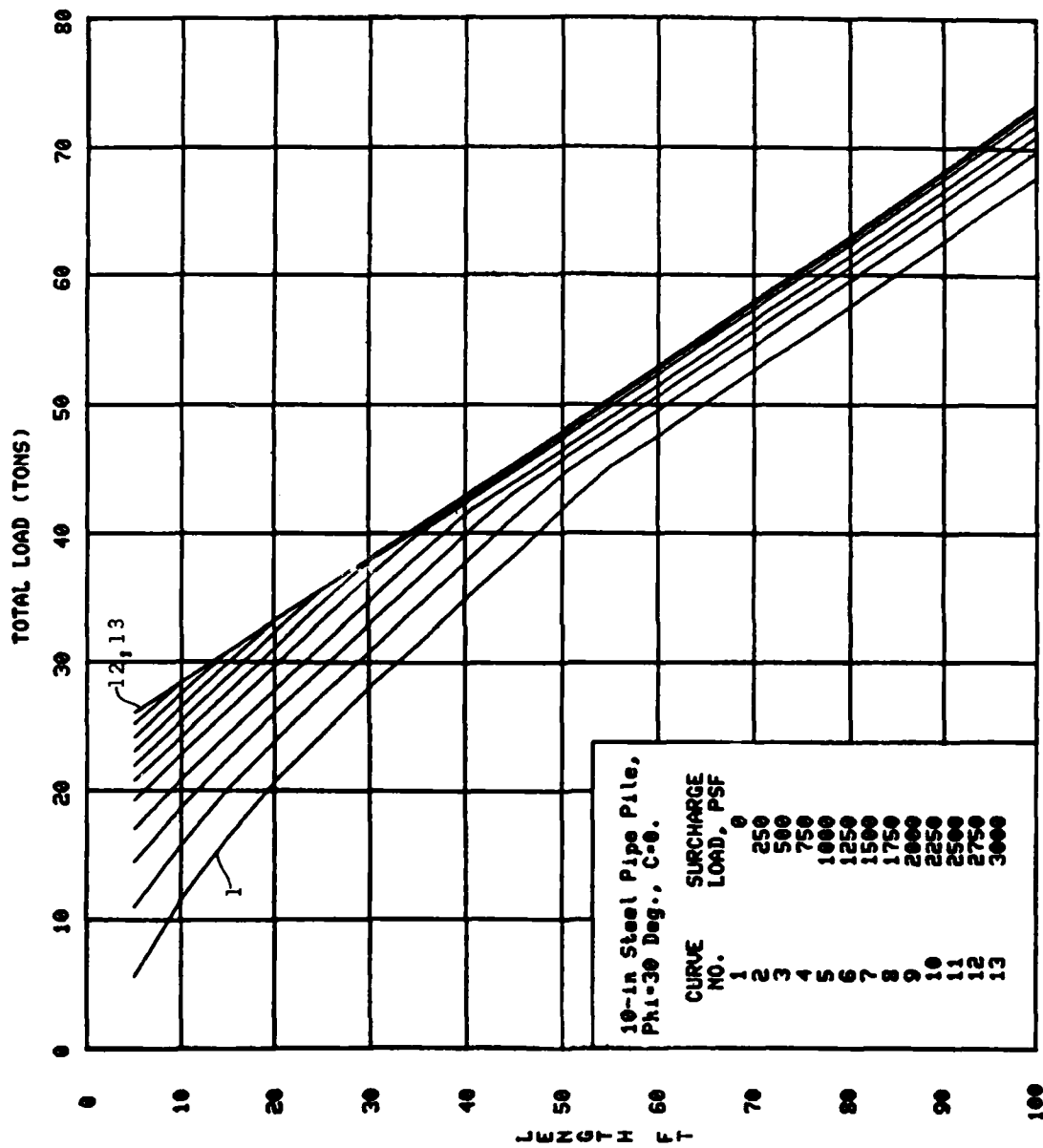


Figure 51. Total Pile Capacity For A 10-in Steel Pipe Pile, Submerged Condition, 1/4-in. Tip Movement, Phi=30 Deg., C=0.



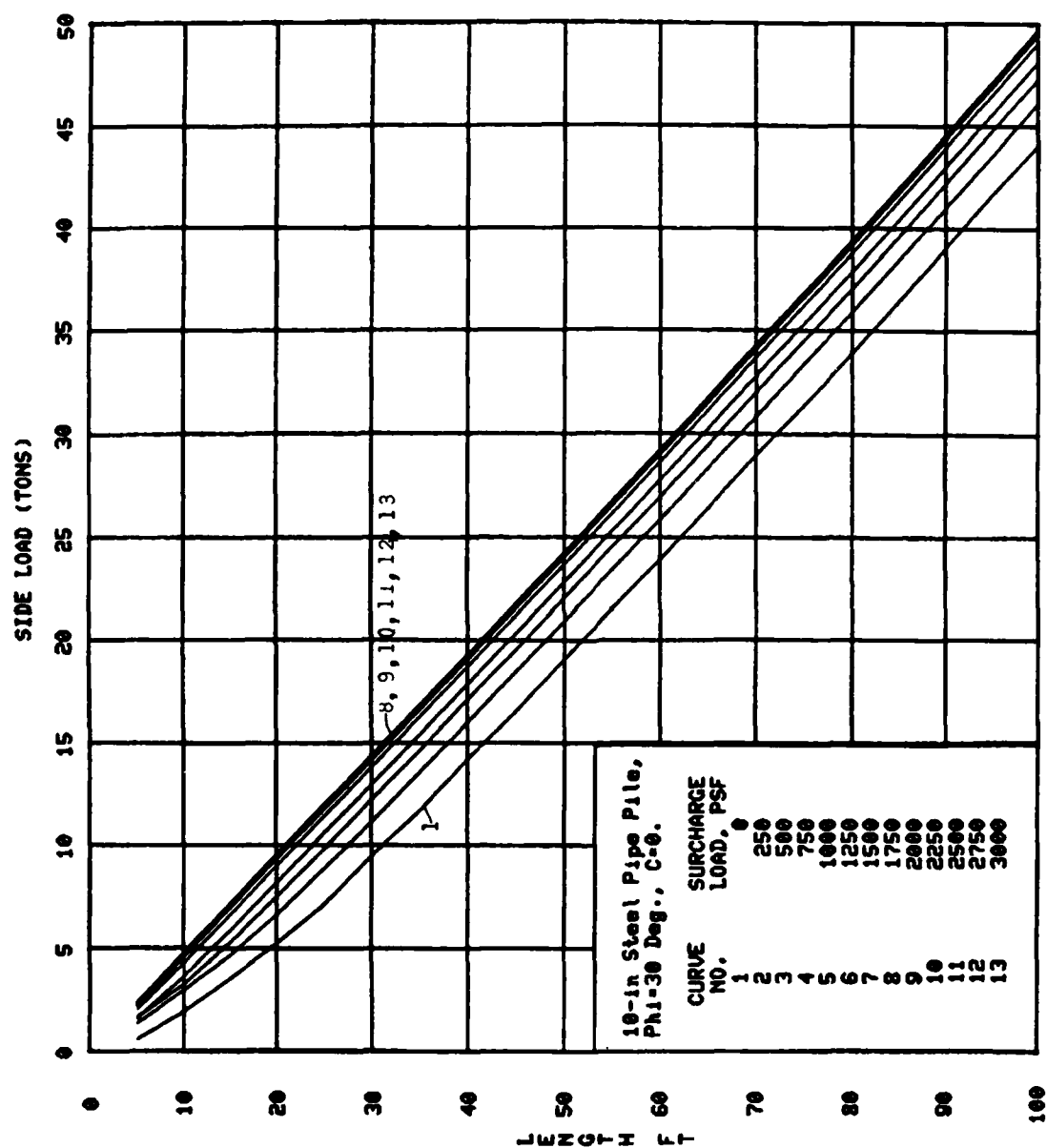


Figure 52. Side Capacity For A 10-in Steel Pipe Pile, Submerged Condition, 1/4-in. Tip Movement, Phi=30 Deg., C=0.



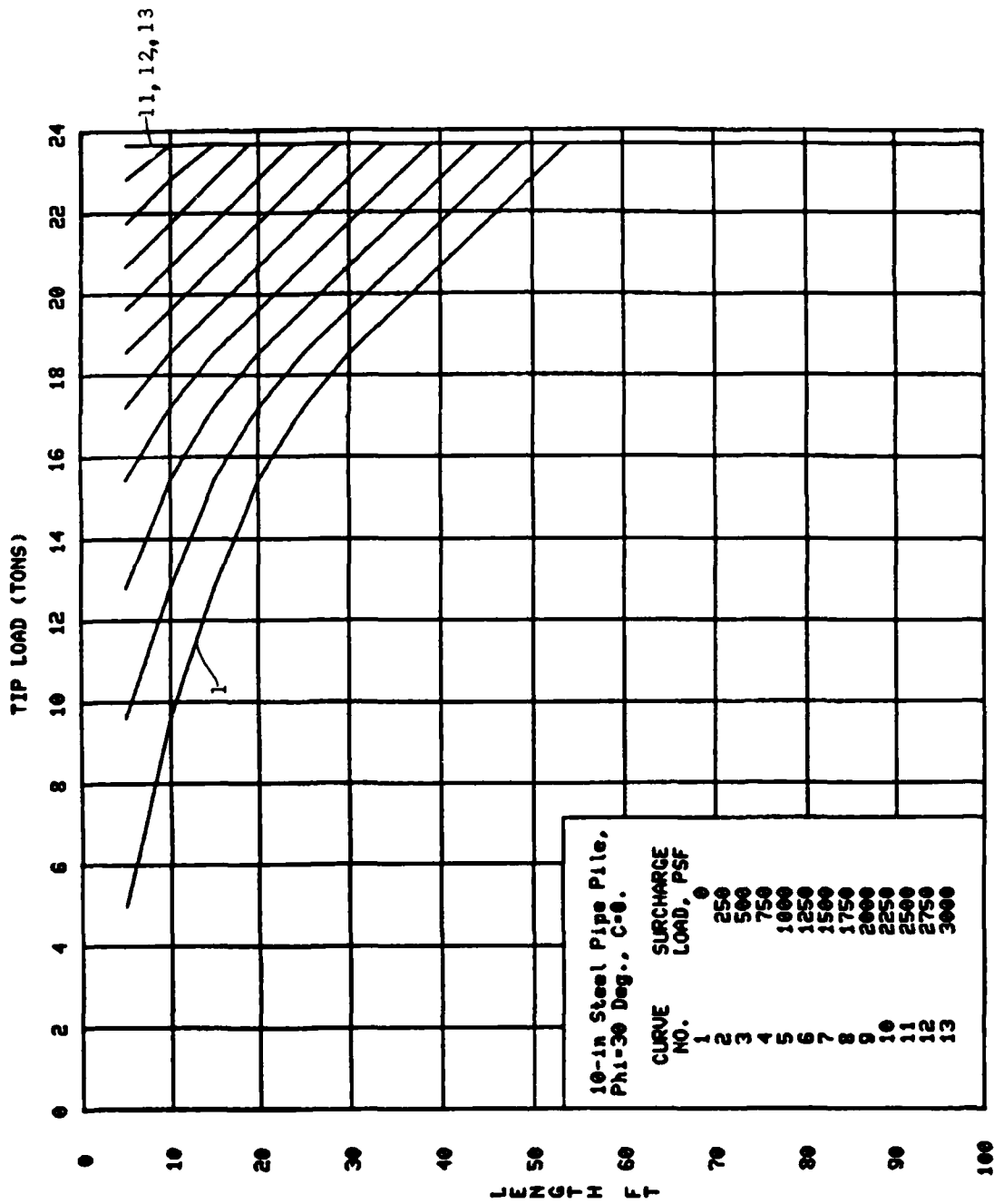


Figure 53. Tip Capacity For A 10-in Steel Pipe Pile,  
 Submerged Condition,  $1/4$ -in. Tip Movement,  $\Phi=30$  Deg.,  $C=0$ .



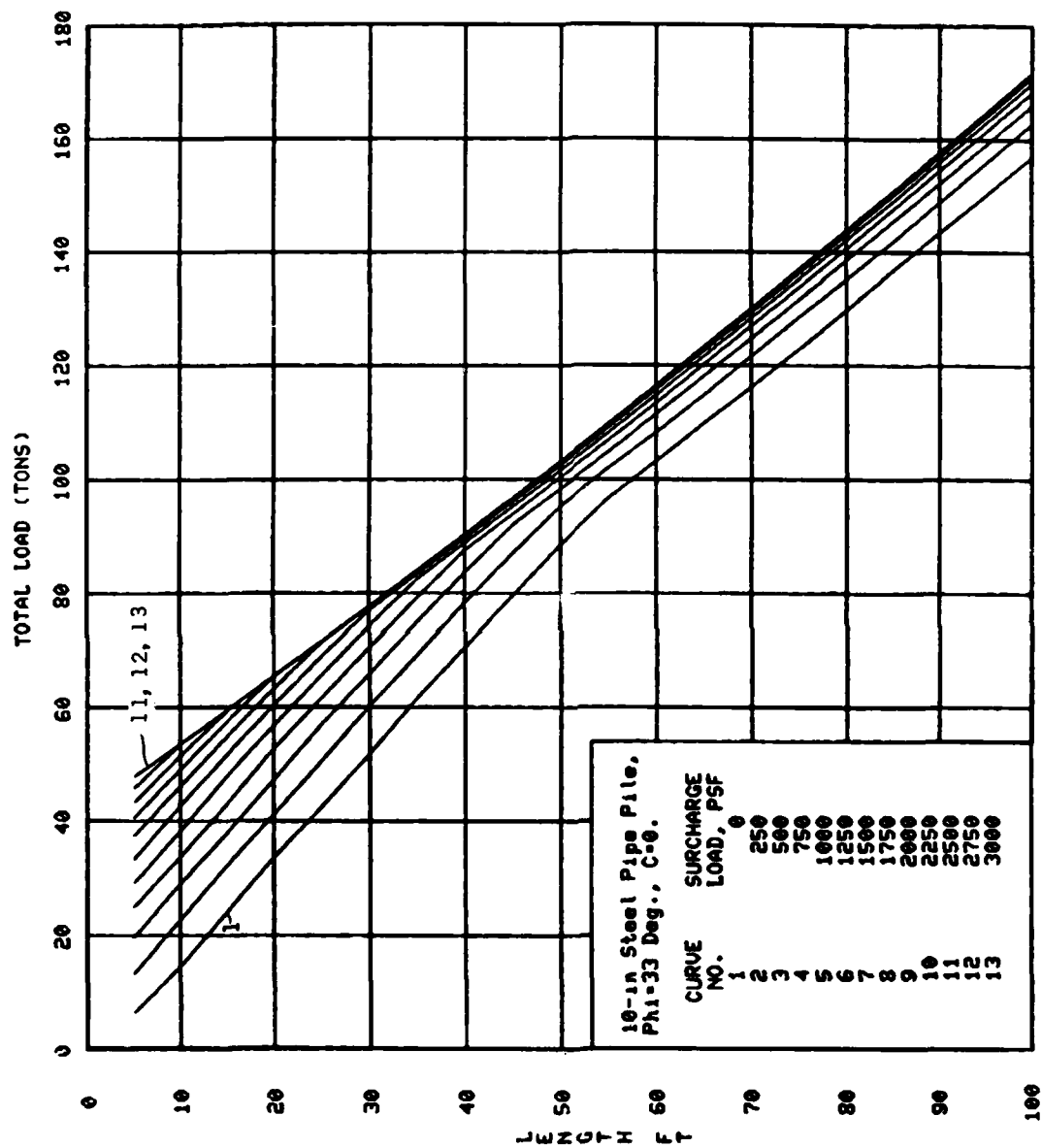


Figure 54. Total Pile Capacity For A 10-in Steel Pipe Pile, Submerged Condition, 1/4-in. Tip Movement, Phi=33 Deg., C=0.



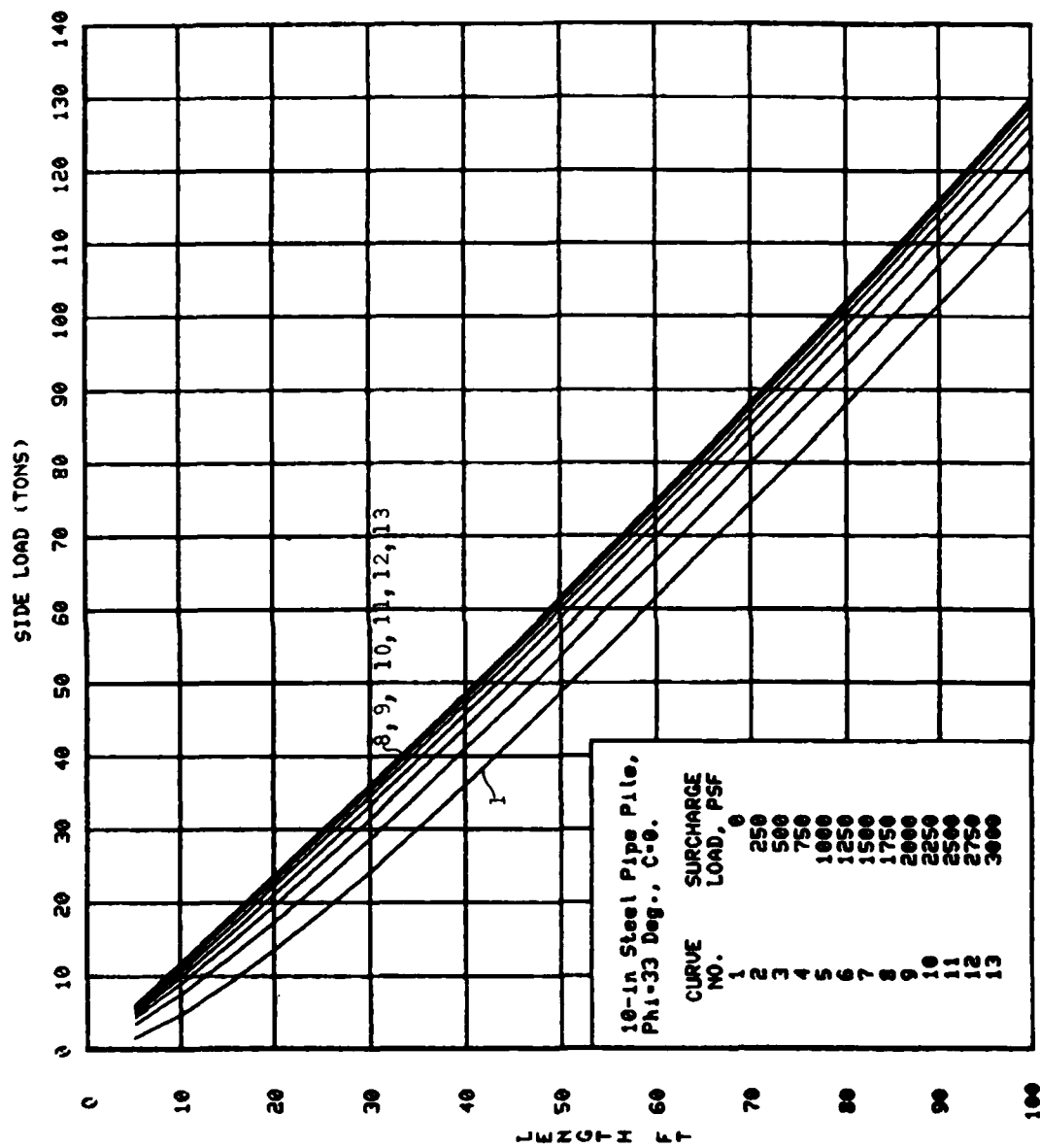


Figure 55. Side Capacity For A 10-in Steel Pipe Pile, Submerged Condition, 1/4-in. Tip Movement, Phi=33 Deg., C=0.



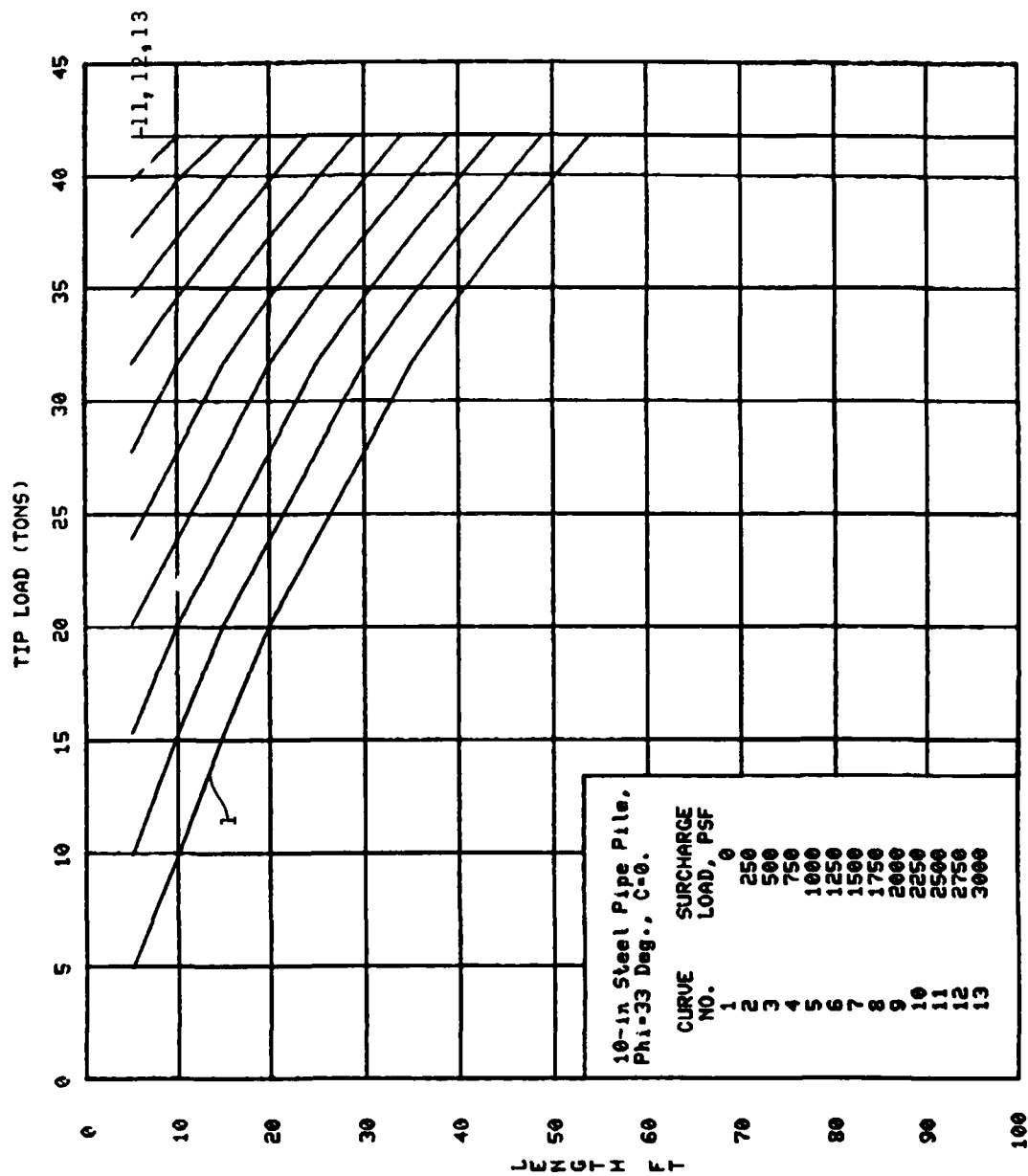


Figure 56. Tip Capacity For A 10-in Steel Pipe Pile, Submerged Condition, 1/4-in. Tip Movement, Phi=33 Deg., C=0.



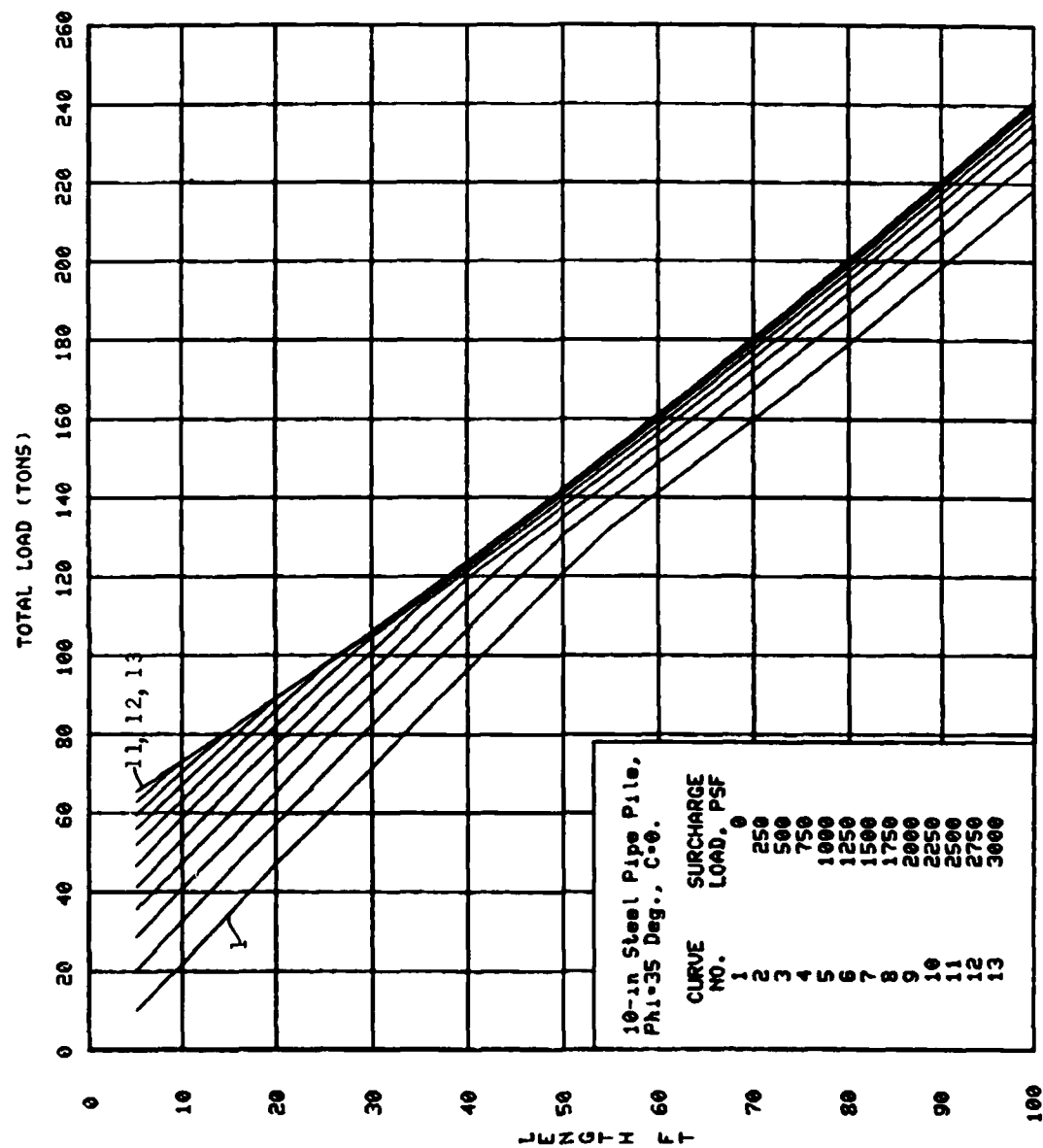


Figure 57. Total Pile Capacity For A 10-in Steel Pipe Pile, Submerged Condition,  $1/4$ -in. Tip Movement,  $\Phi = 35^\circ$  Deg.,  $C = 0$ .



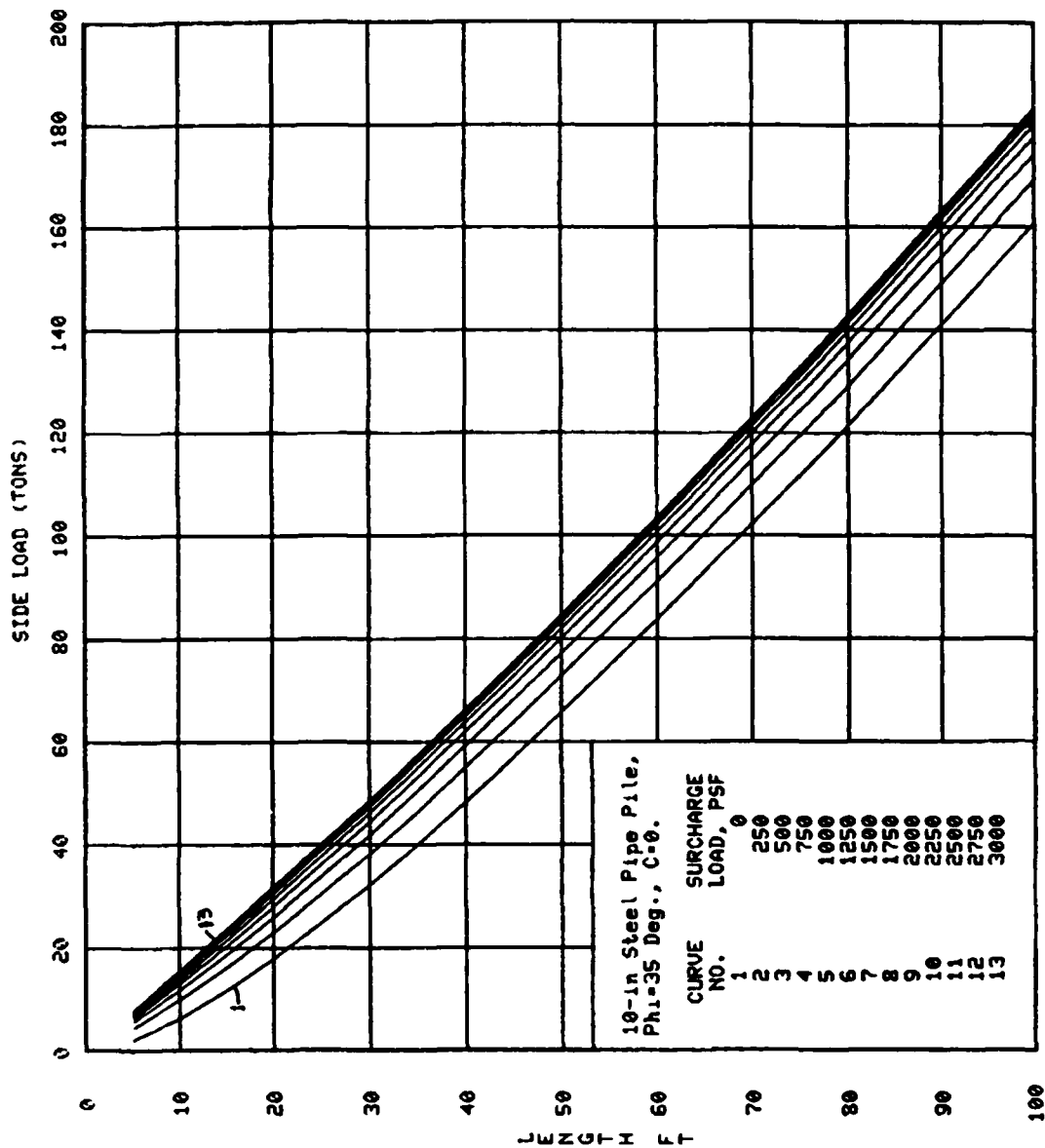


Figure 58. Side Capacity For A 10-in Steel Pipe Pile,  
Submerged Condition, 1/4-in. Tip Movement, Phi=35 Deg., C=0.



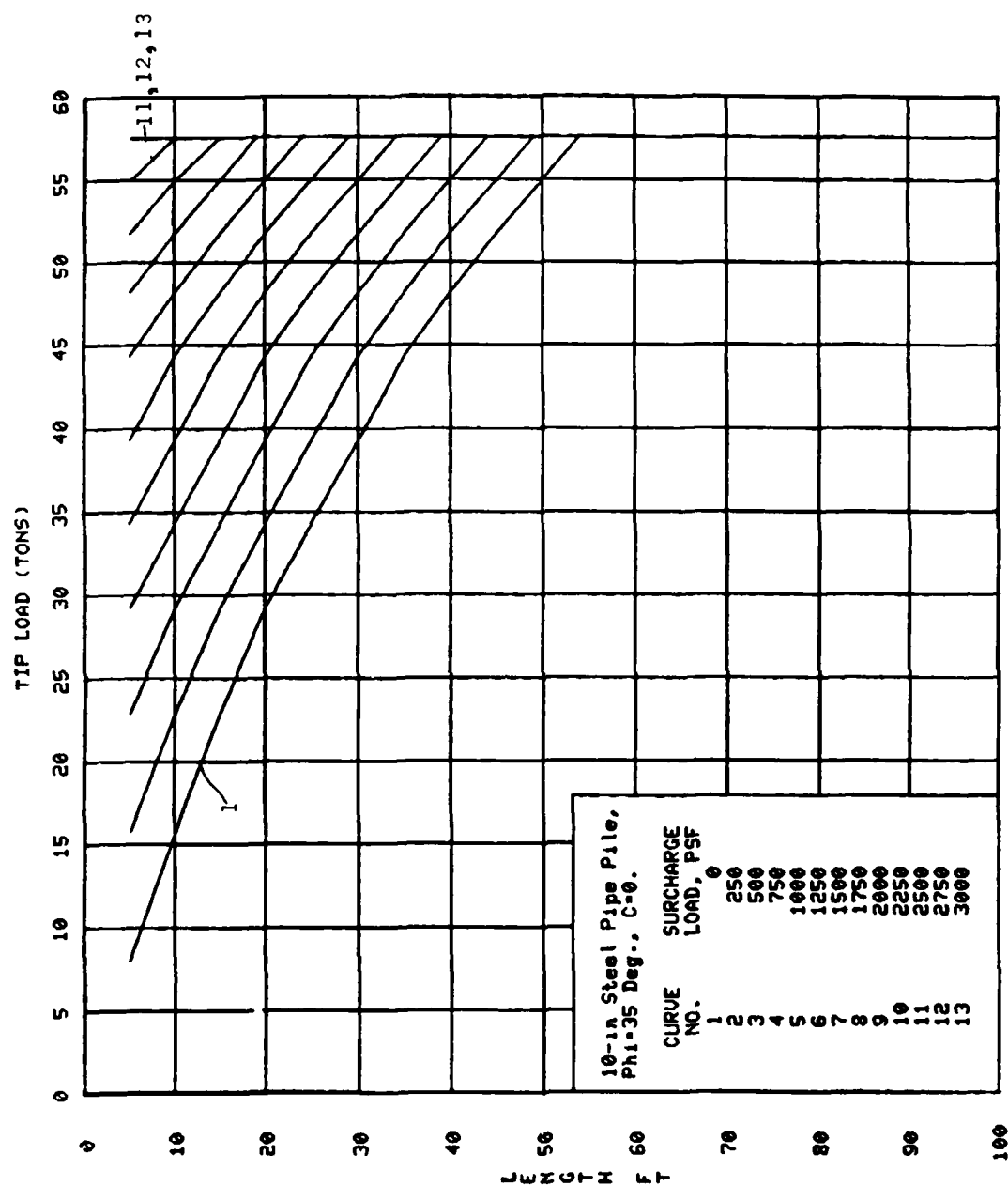


Figure 59. Tip Capacity For A 10-in Steel Pipe Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi=35$  Deg.,  $C=0$ .



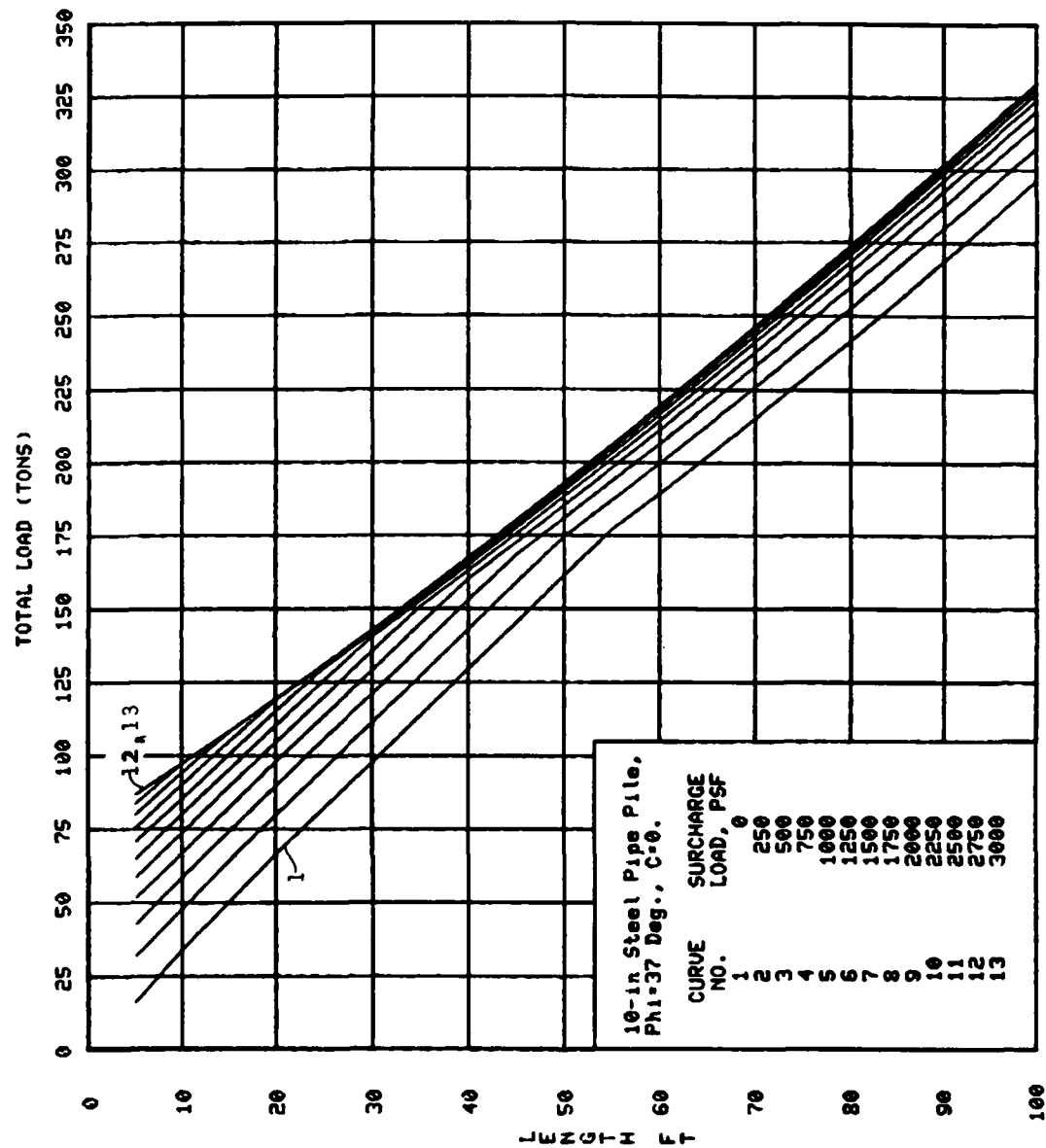


Figure 60. Total Pile Capacity For A 10-in Steel Pipe Pile, Submerged Condition, 1/4-in. Tip Movement, Phi=37 Deg., C=0.



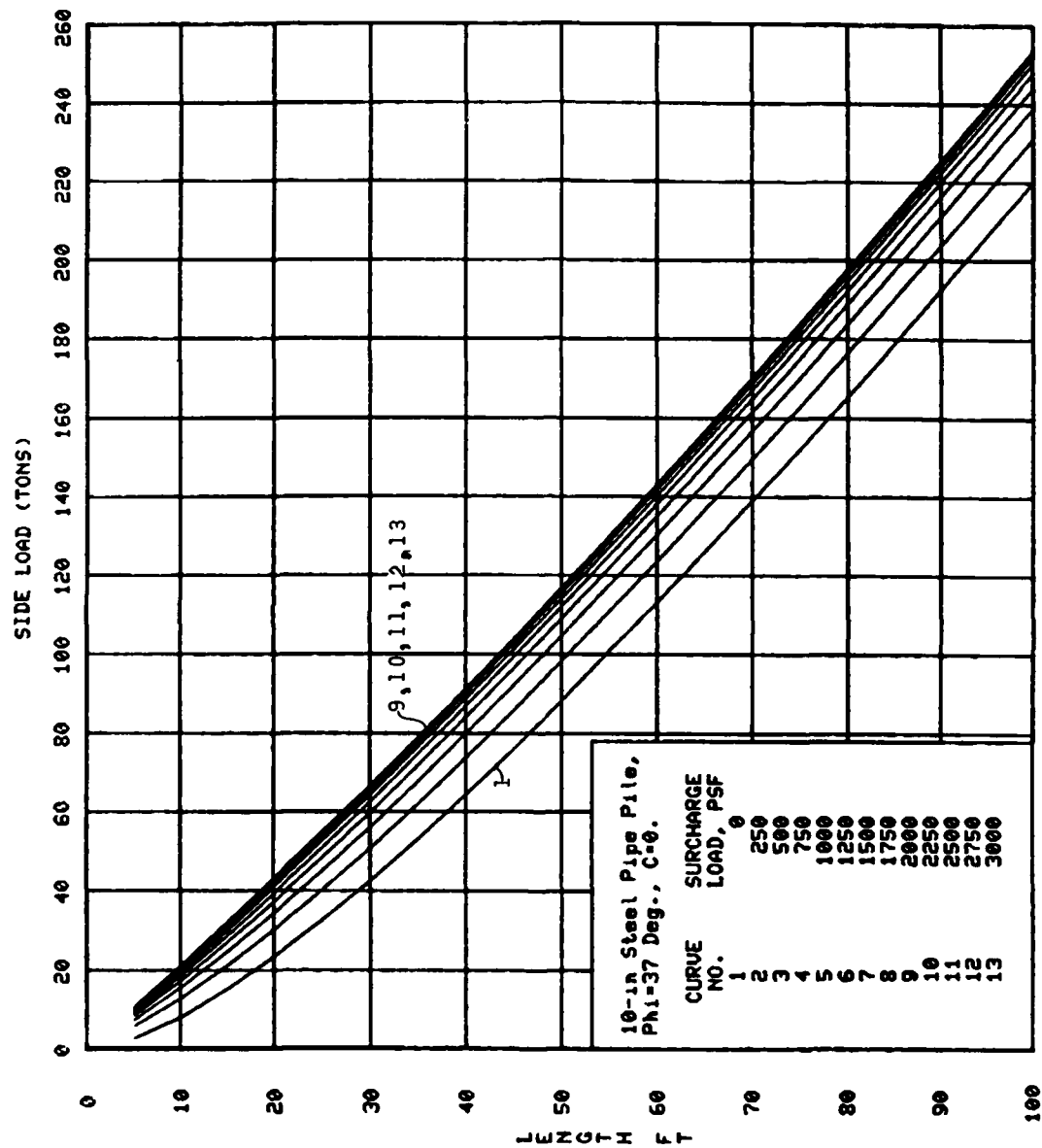


Figure 61. Side Capacity For A 10-in Steel Pipe Pile, Submerged Condition, 1/4-in. Tip Movement, Phi=37 Deg., C=0.



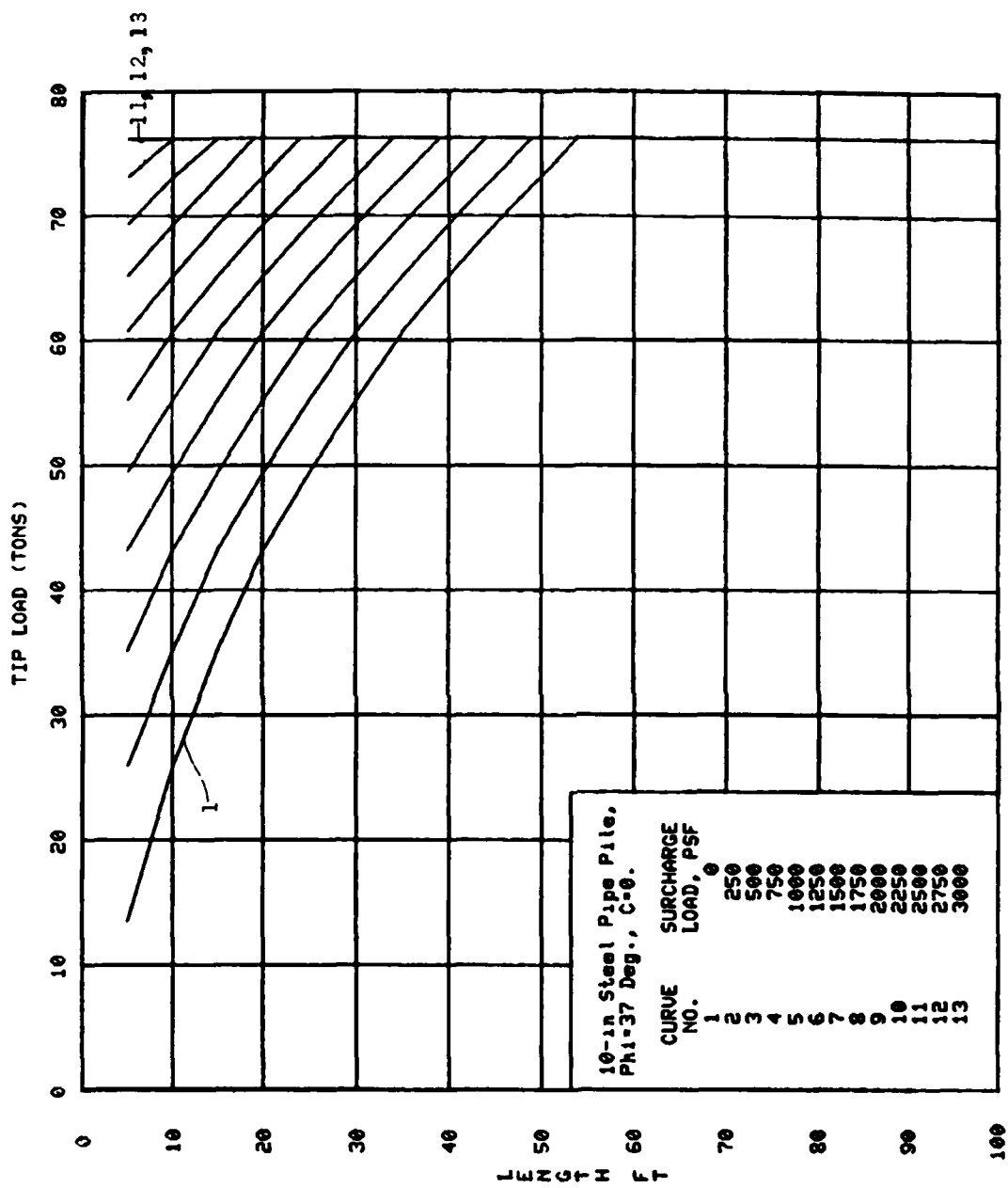


Figure 62. Tip Capacity For A 10-in Steel Pipe Pile,  
Submerged Condition, 1/4-in. Tip Movement, Phi=37 Deg., C=0.



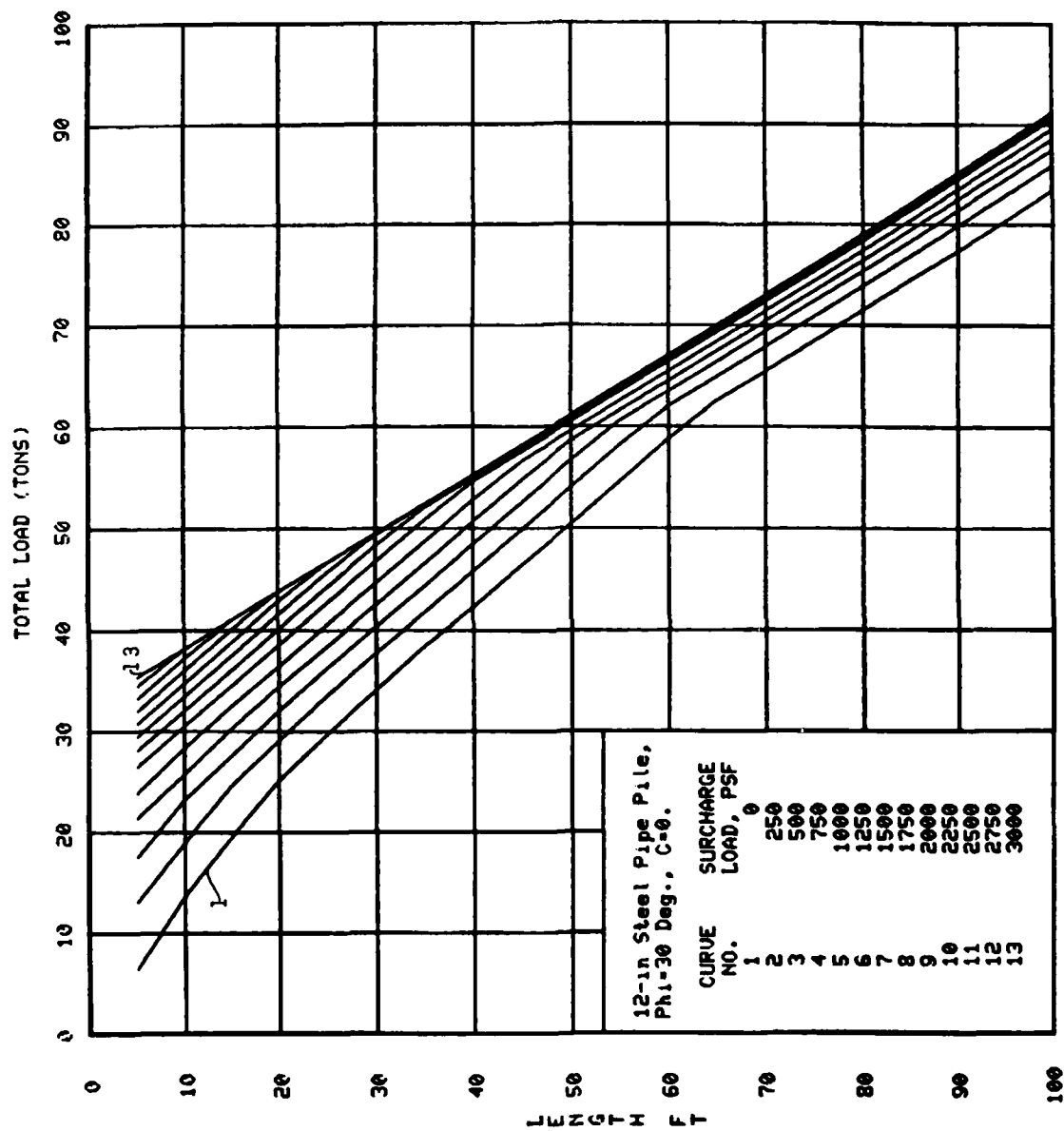


Figure 63. Total Pile Capacity For A 12-in Steel Pipe Pile, Submerged Condition,  $1/4$ -in. Tip Movement,  $\Phi=30$  Deg.,  $C=0$ .



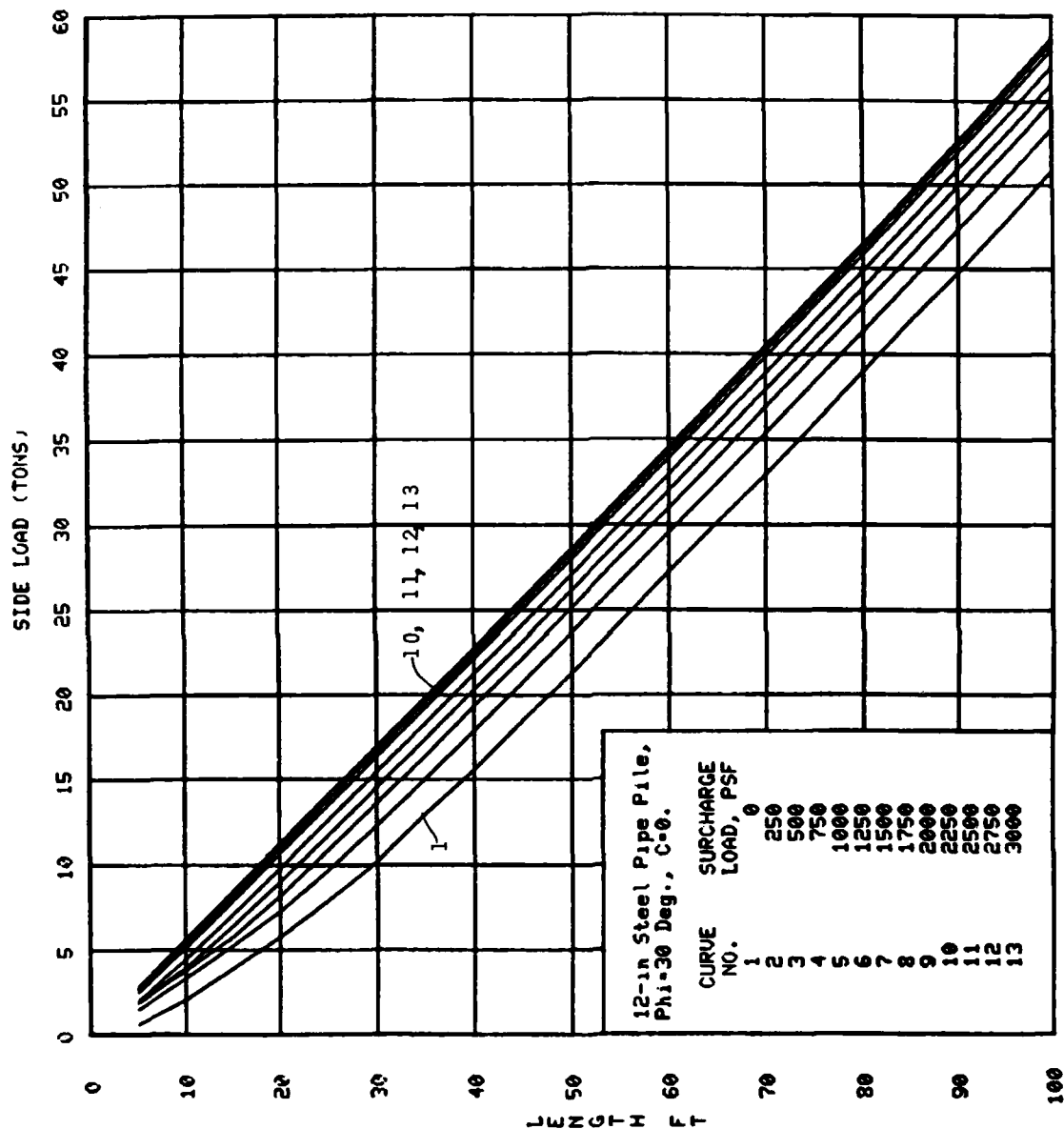


Figure 64. Side Capacity For A 12-in Steel Pipe Pile,  
Submerged Condition, 1/4-in. Tip Movement, Phi=30 Deg., C=0.



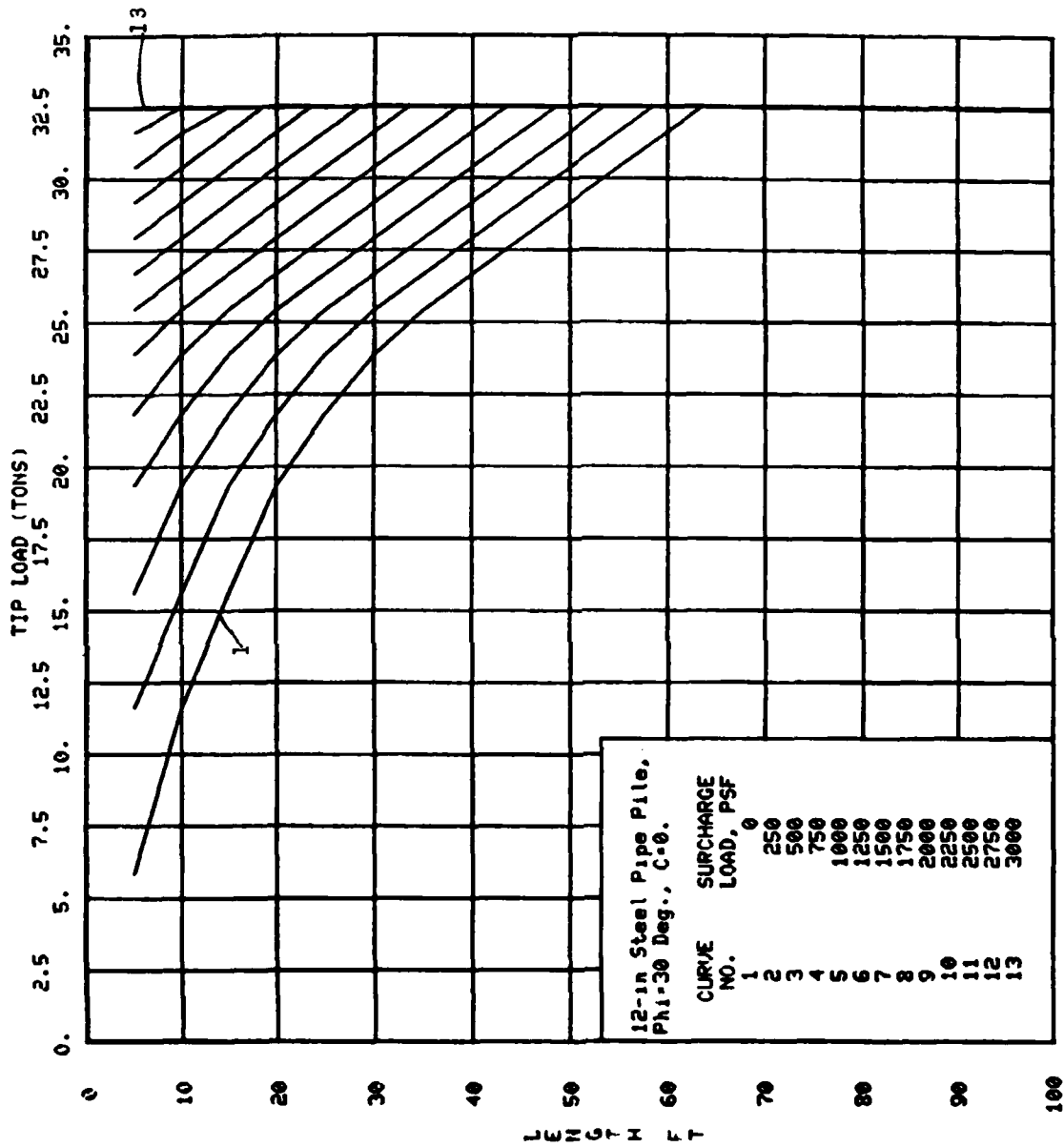


Figure 65. Tip Capacity For A 12-in Steel Pipe Pile,  
Submerged Condition, 1/4-in. Tip Movement, Phi=30 Deg., C=0.



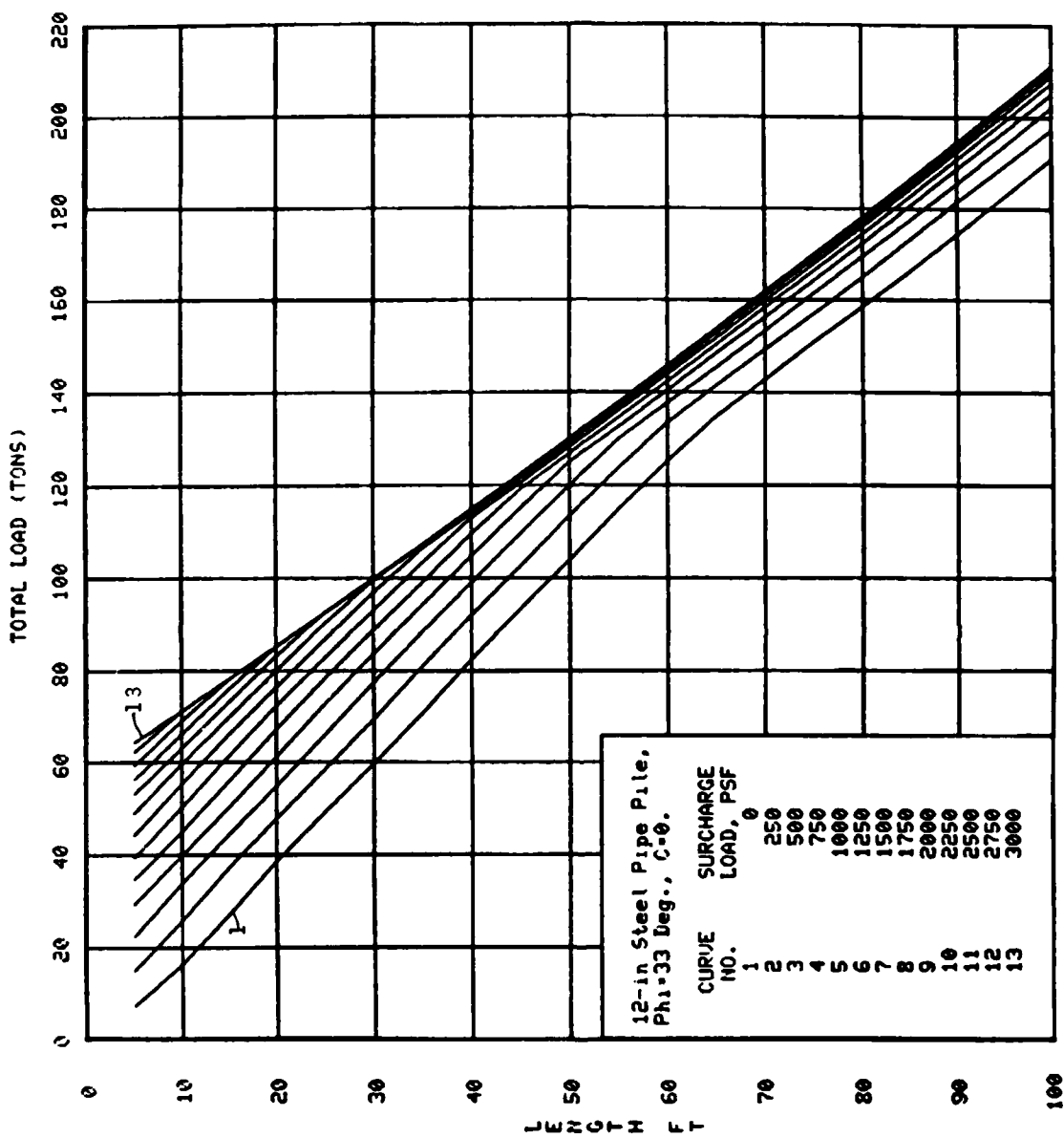


Figure 66. Total Pile Capacity For A 12-in Steel Pipe Pile, Submerged Condition, 1/4-in. Tip Movement, Phi=33 Deg., C=0.



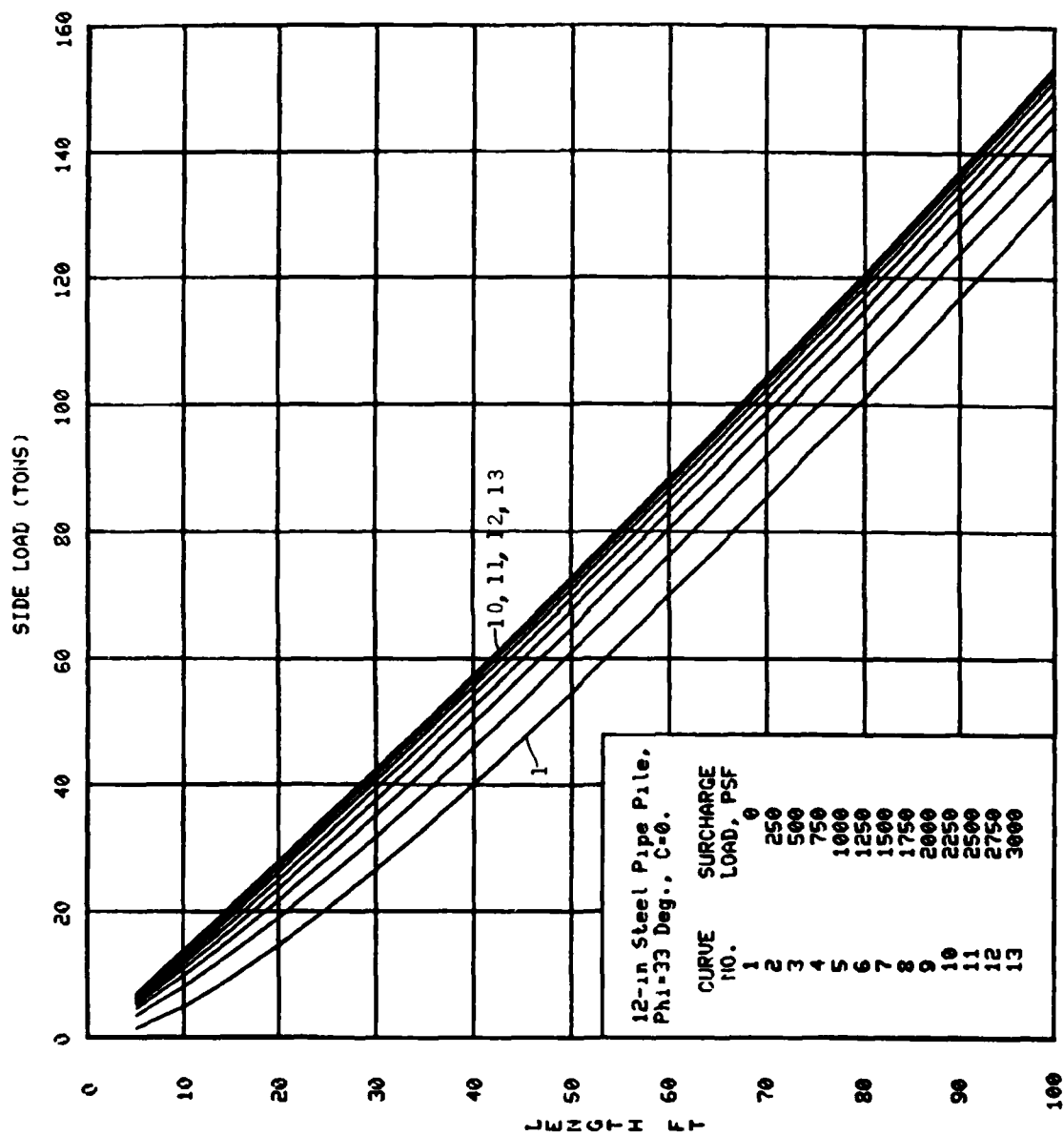


Figure 67. Side Capacity For A 12-in Steel Pipe Pile,  
Submerged Condition, 1/4-in. Tip Movement, Phi=33 Deg., C=0.



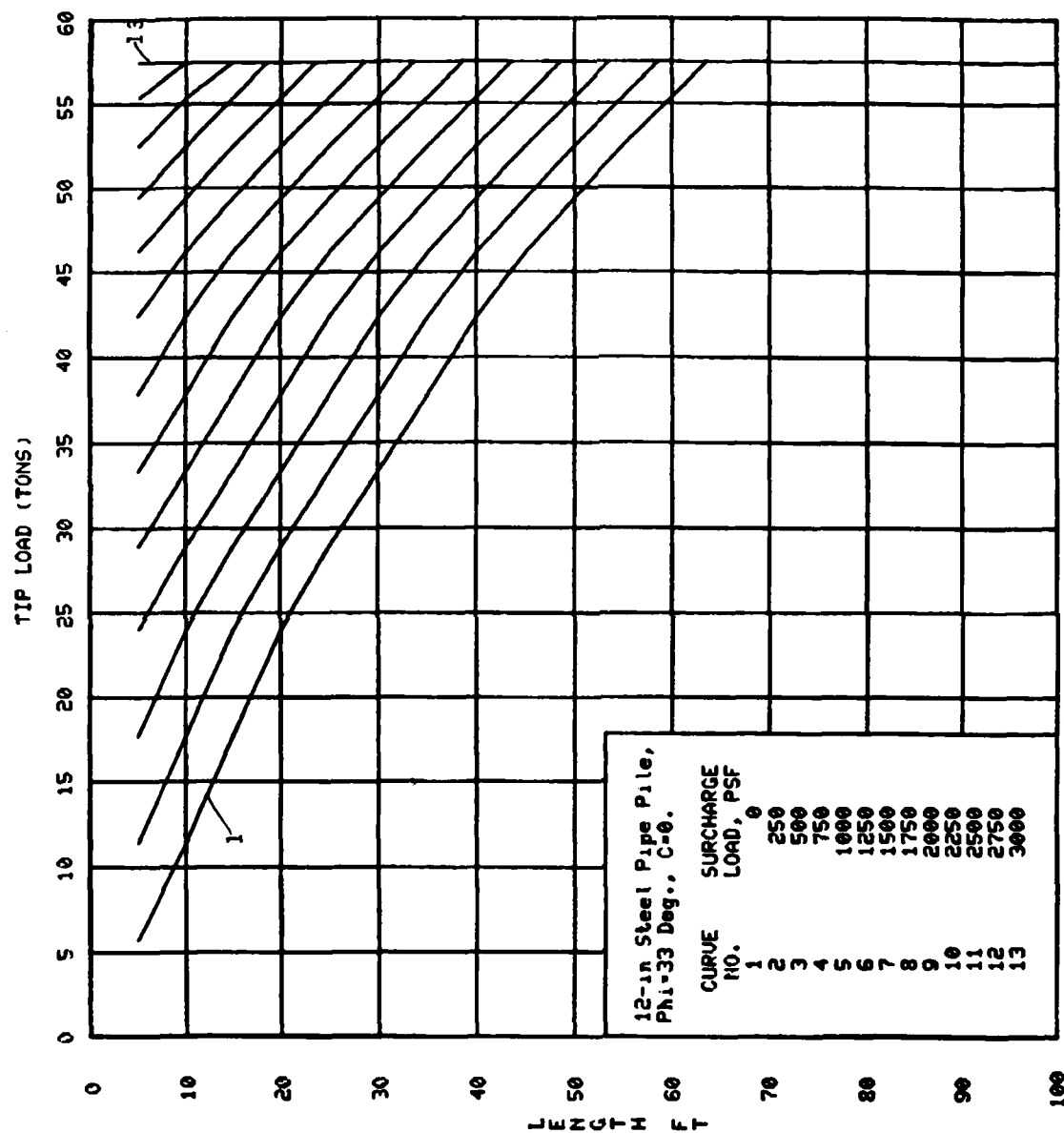


Figure 68. Tip Capacity For A 12-in Steel Pipe Pile, Submerged Condition, 1/4-in. Tip Movement, Phi-33 Deg., C=0.



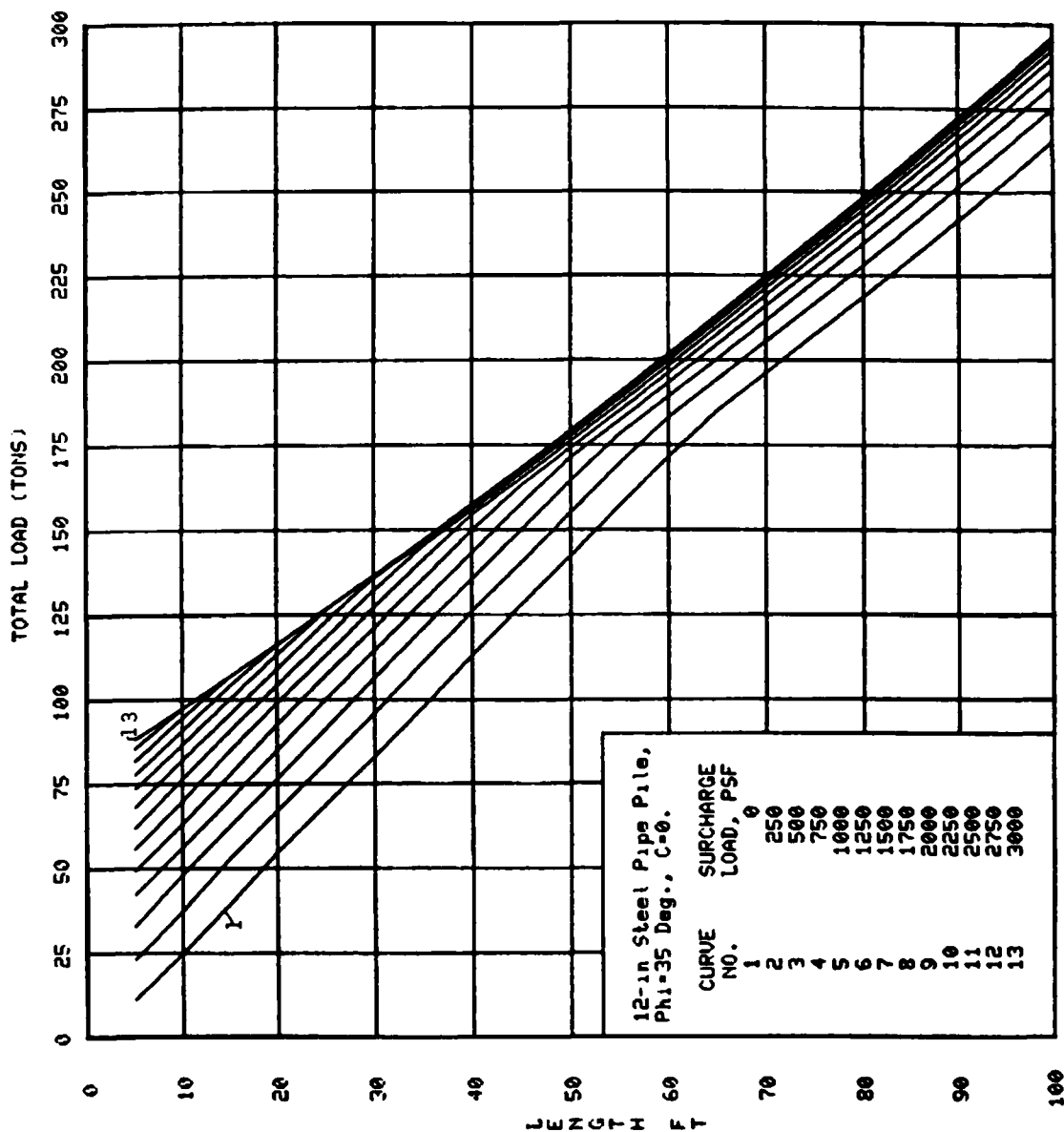


Figure 69. Total Pile Capacity For A 12-in Steel Pipe Pile, Submerged Condition, 1/4-in. Tip Movement, Phi=35 Deg., C=0.



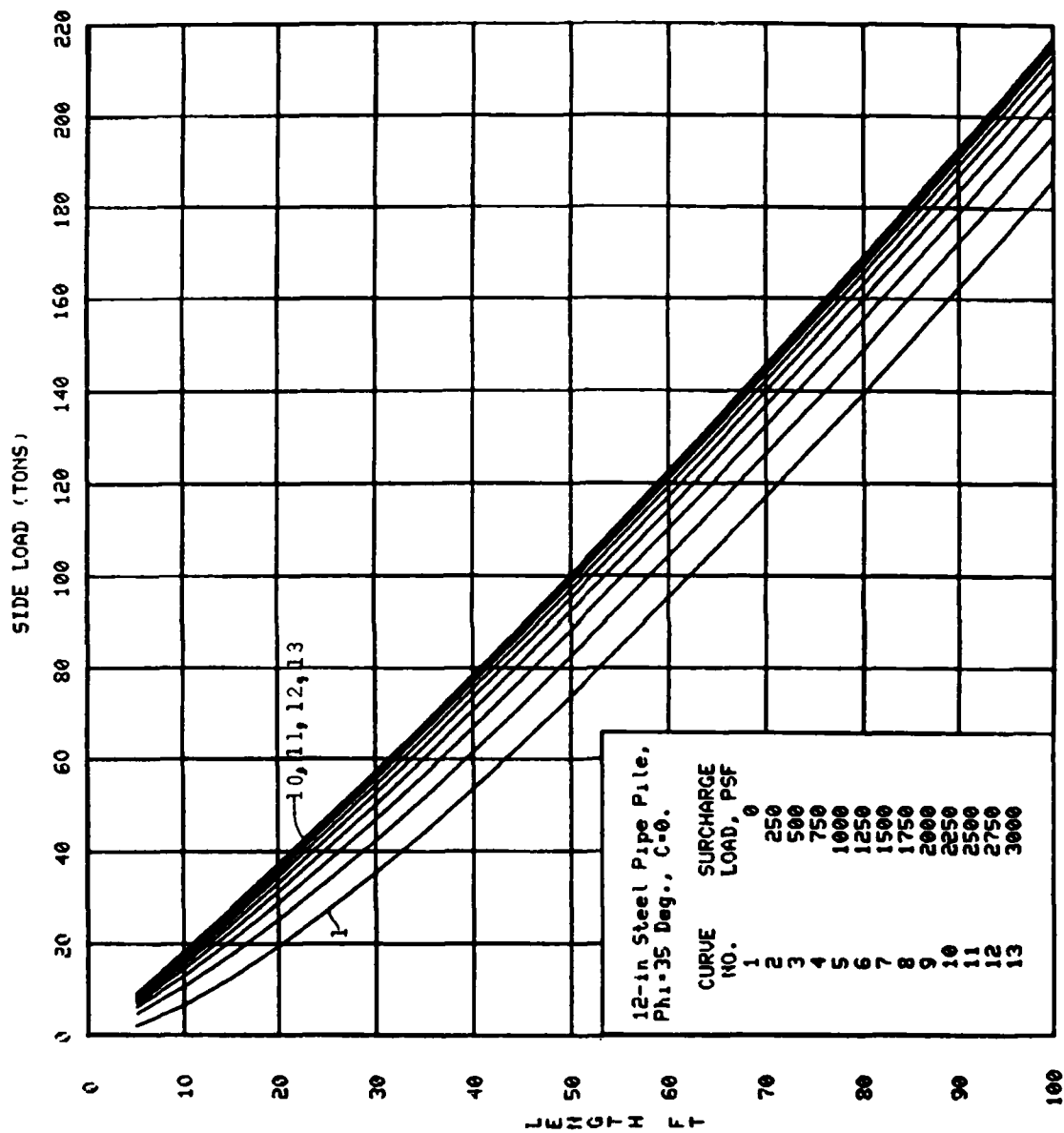


Figure 70. Side Capacity For A 12-in Steel Pipe Pile, Submerged Condition, 1/4-in. Tip Movement, Phi=35 Deg., C=0.



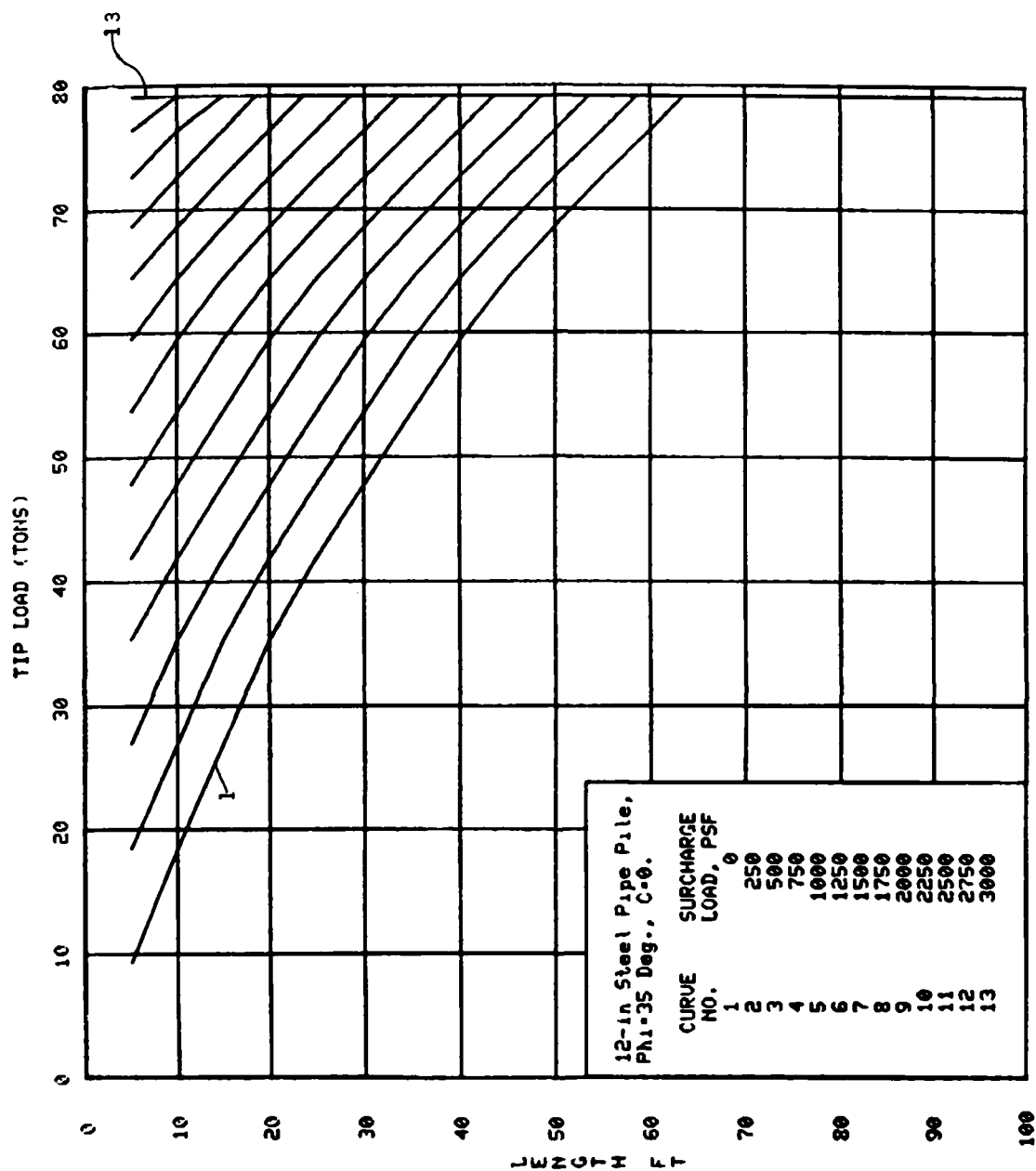


Figure 71. Tip Capacity For A 12-in Steel Pipe Pile,  
Submerged Condition, 1/4-in. Tip Movement, Phi=35 Deg., C=0.



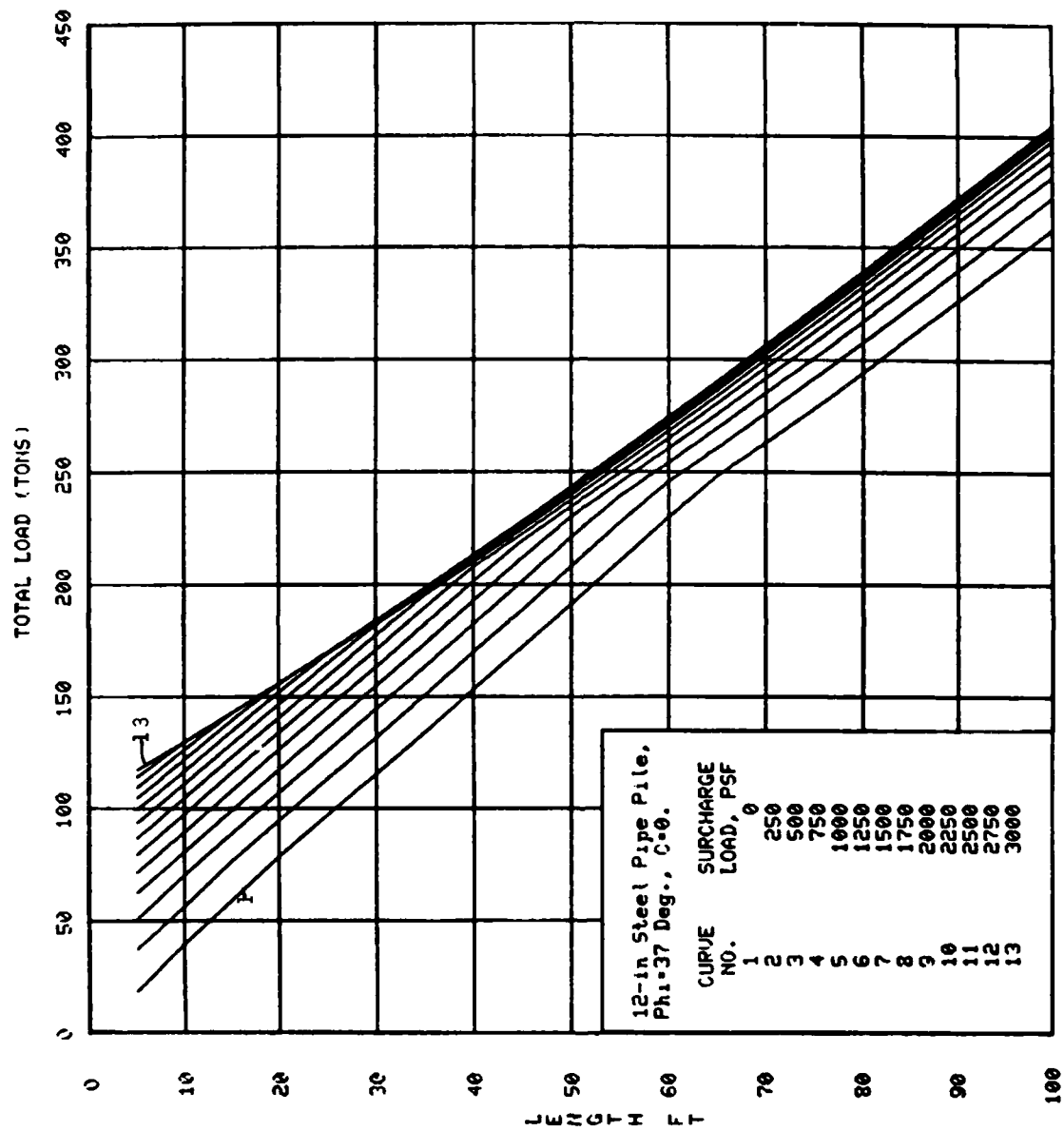


Figure 72. Total Pile Capacity For A 12-in Steel Pipe Pile, Submerged Condition,  $1/4$ -in. Tip Movement,  $\Phi = 37^\circ$  Deg.,  $C = 0$ .



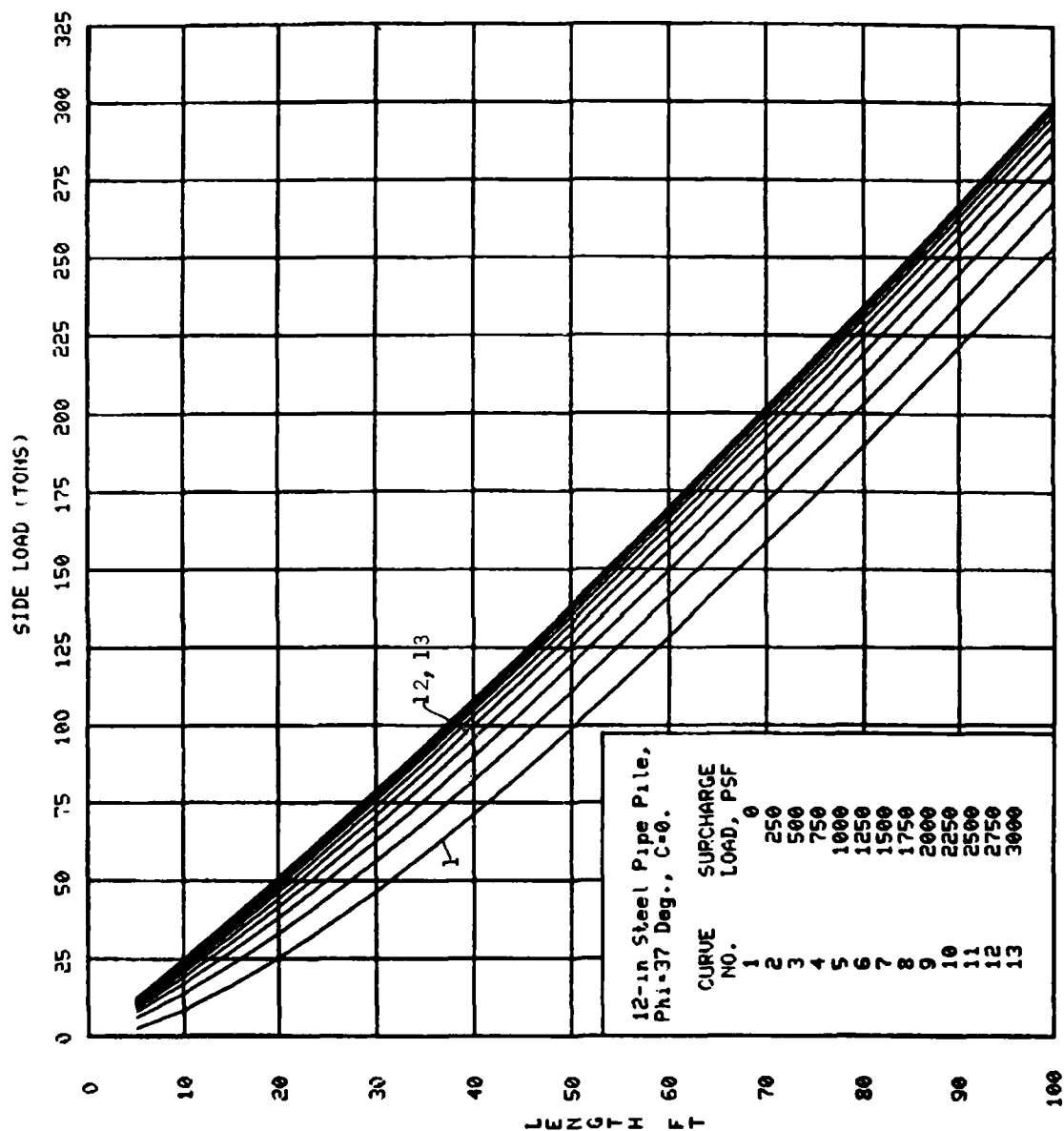


Figure 73. Side Capacity For A 12-in Steel Pipe Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi=37$  Deg.,  $C=0$ .



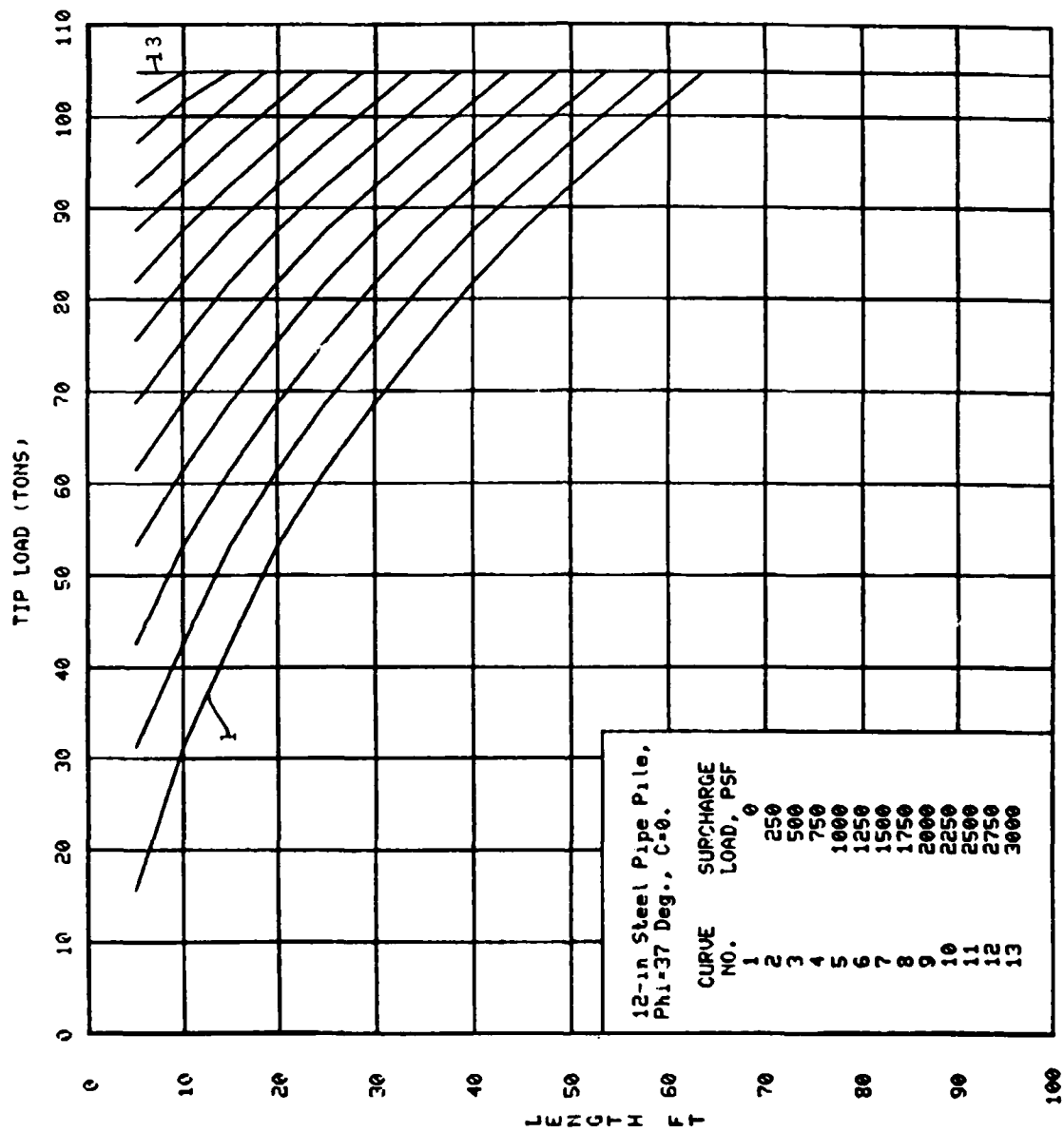


Figure 74. Tip Capacity For A 12-in Steel Pipe Pile,  
 Submerged Condition,  $1/4$ -in. Tip Movement,  $\Phi=37$  Deg.,  $C=0$ .



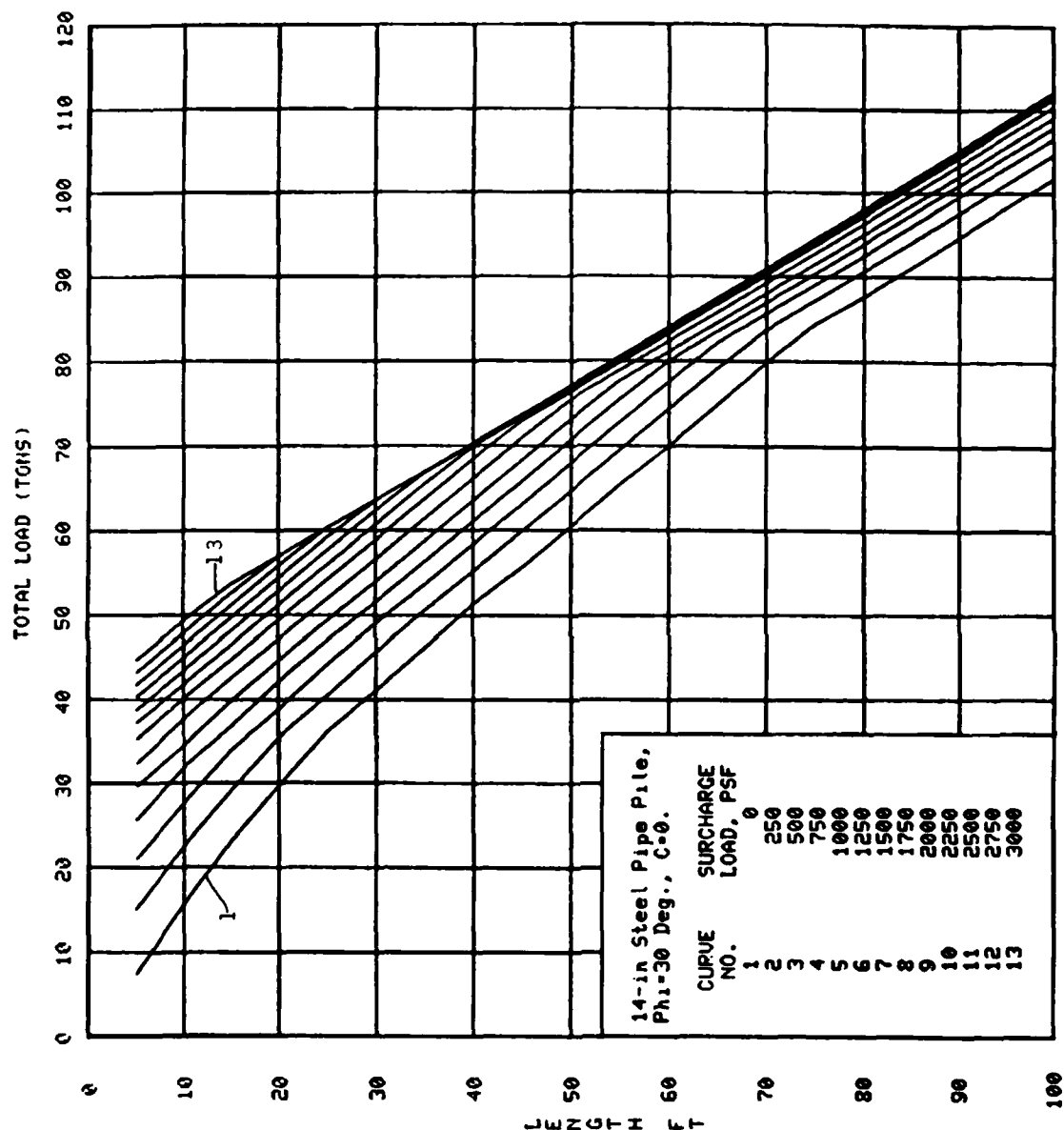


Figure 75. Total Pile Capacity For A 14-in Steel Pipe Pile, Submerged Condition, 1/4-in. Tip Movement, Phi=30 Deg., C=0.



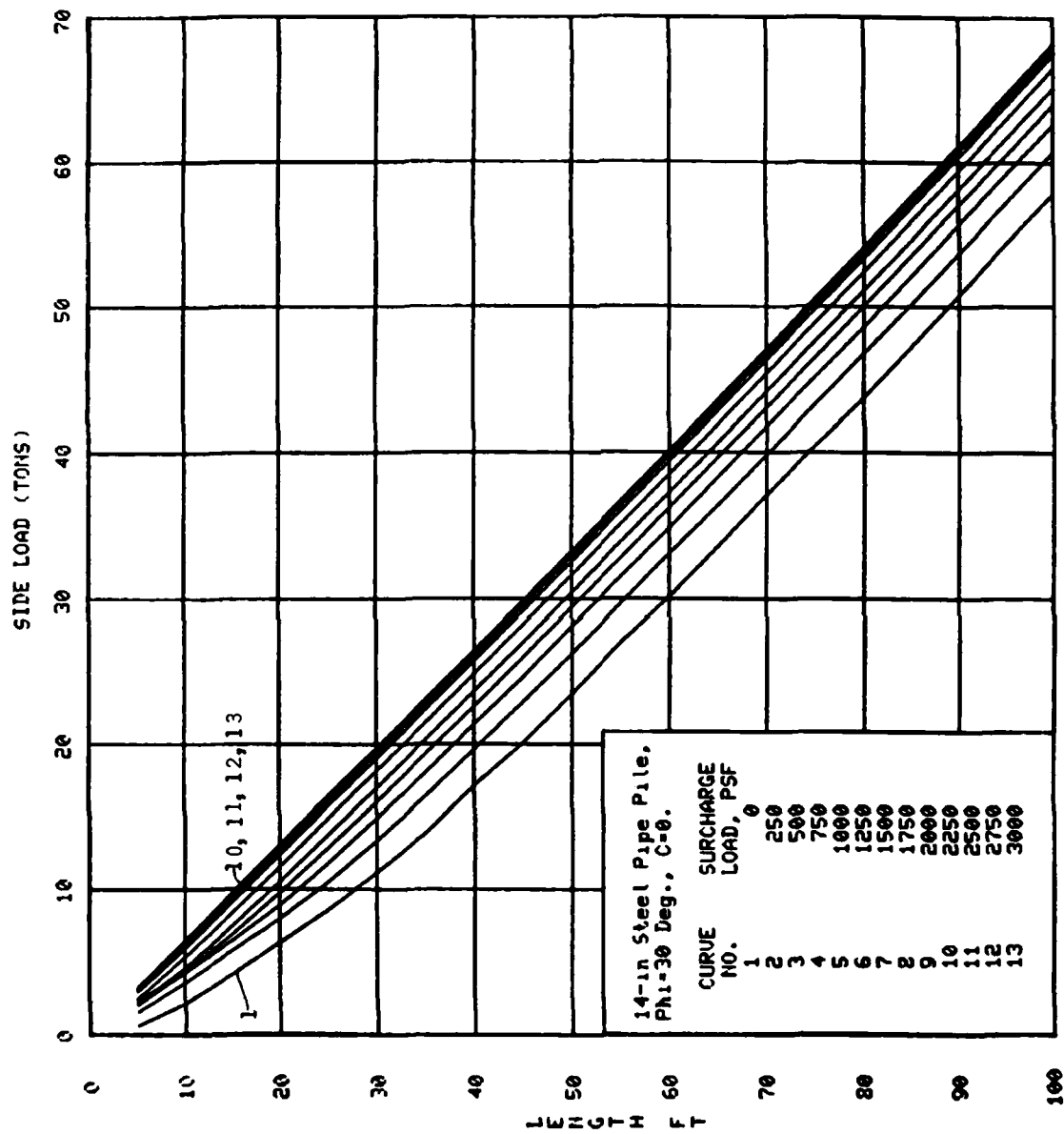


Figure 76. Side Capacity For A 14-in Steel Pipe Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi=30$  Deg.,  $C=0$ .



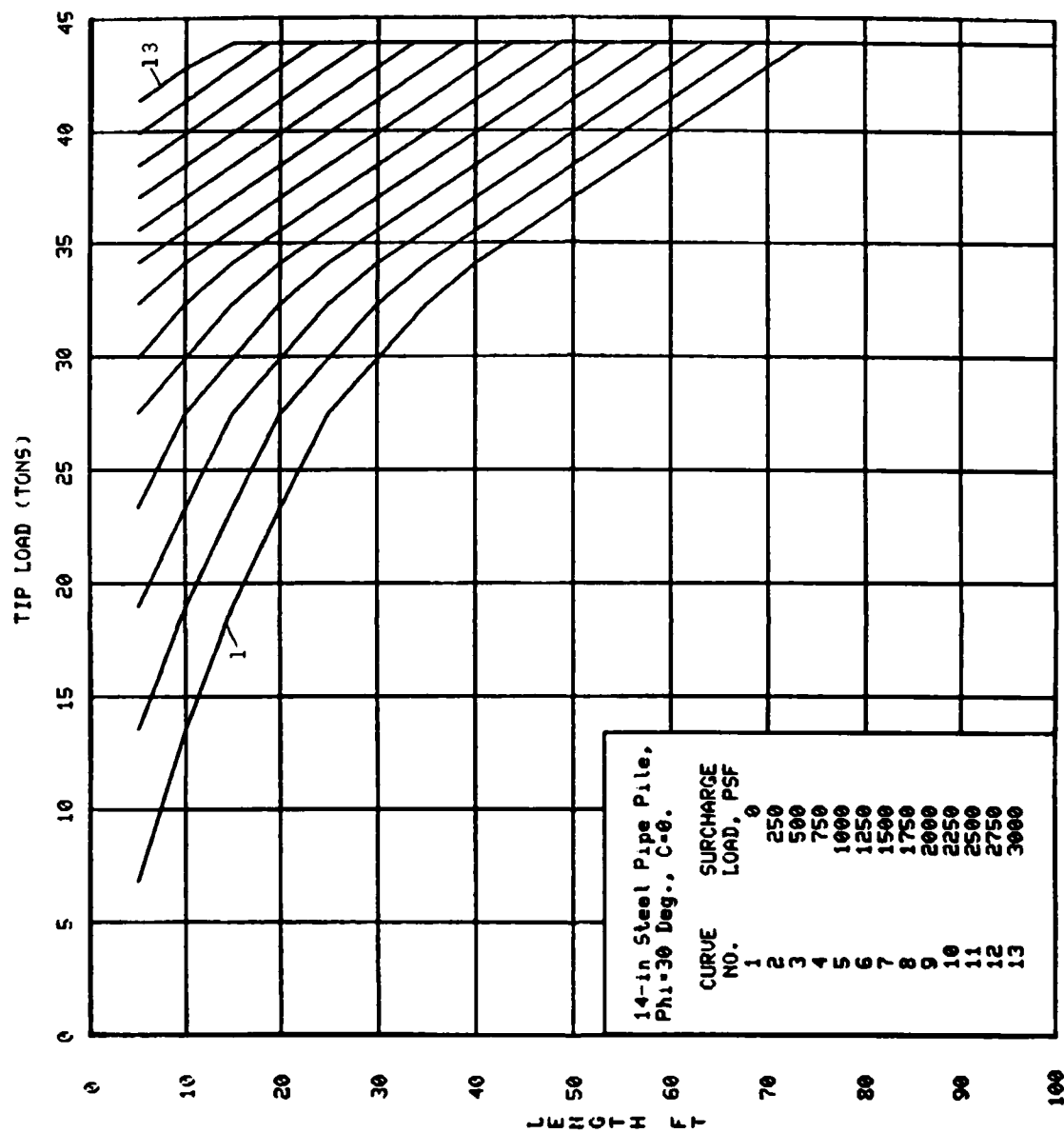


Figure 77. Tip Capacity For A 14-in Steel Pipe Pile,  
 Submerged Condition,  $1/4$ -in. Tip Movement,  $\Phi=30^\circ$  Deg.,  $C=0$ .



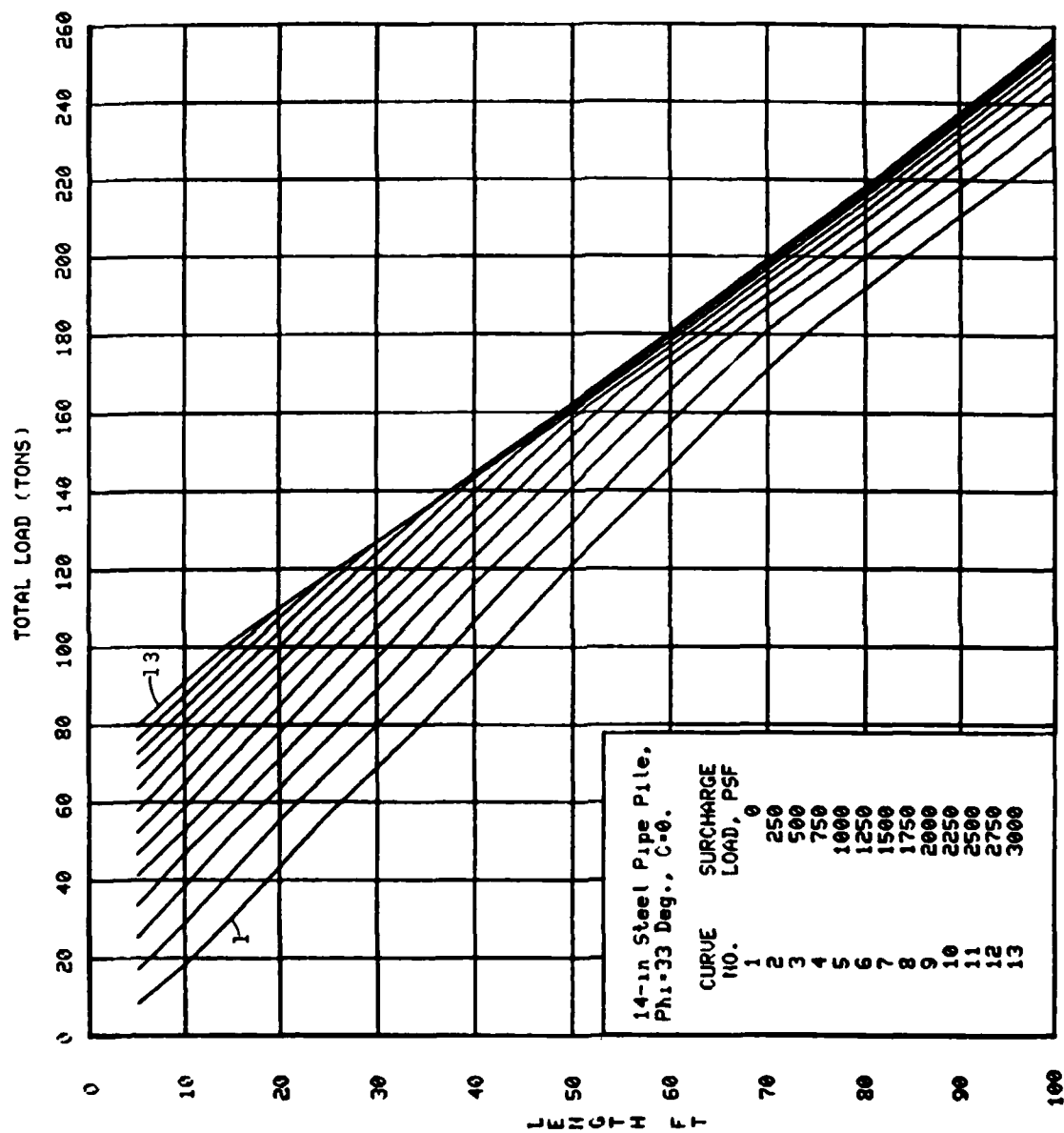


Figure 78. Total Pile Capacity For A 14-in Steel Pipe Pile, Submerged Condition, 1/4-in. Tip Movement, Phi=33 Deg., C=0.



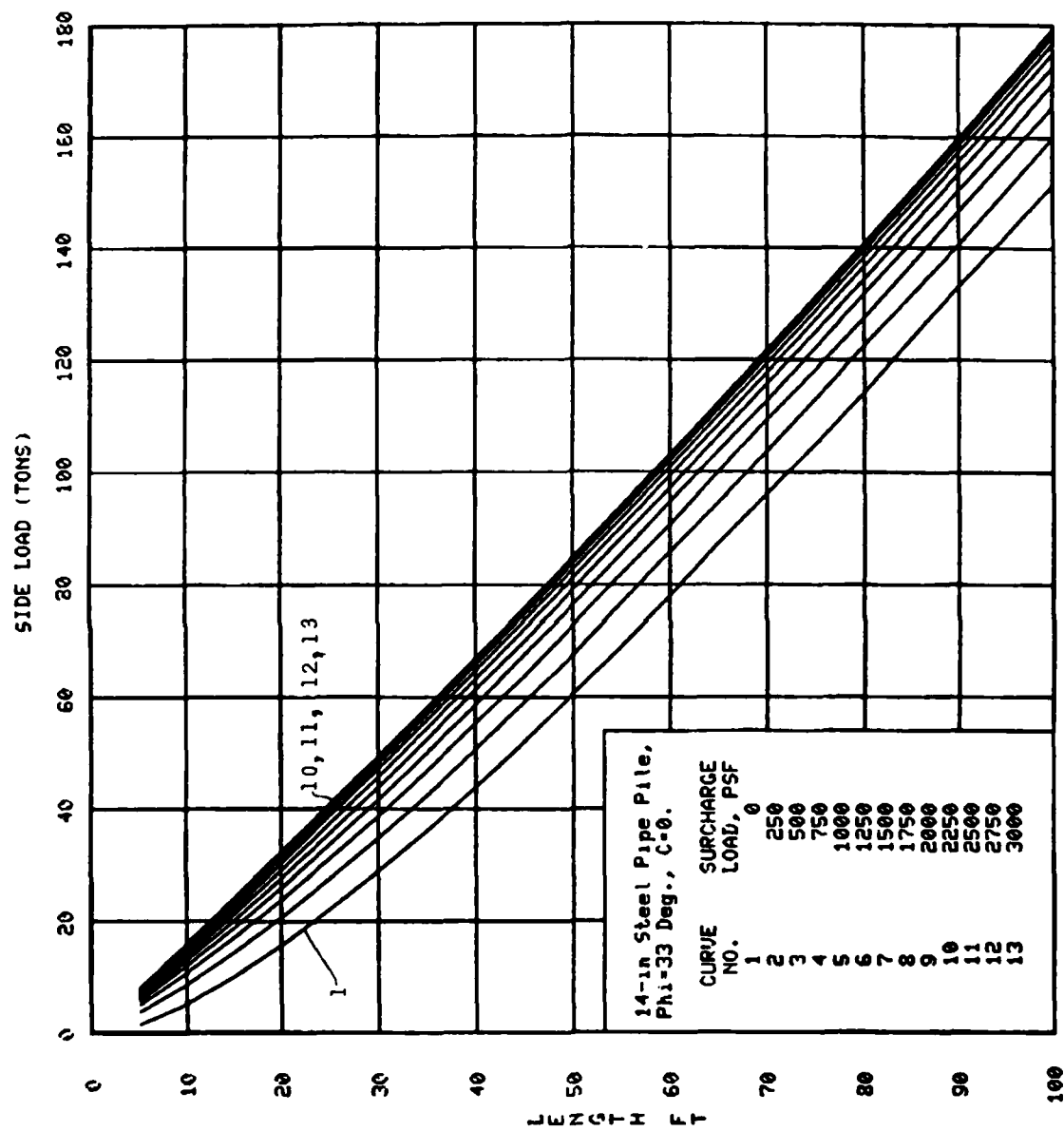


Figure 79. Side Capacity For A 14-in Steel Pipe Pile,  
Submerged Condition, 1/4-in. Tip Movement, Phi=33 Deg., C=0.



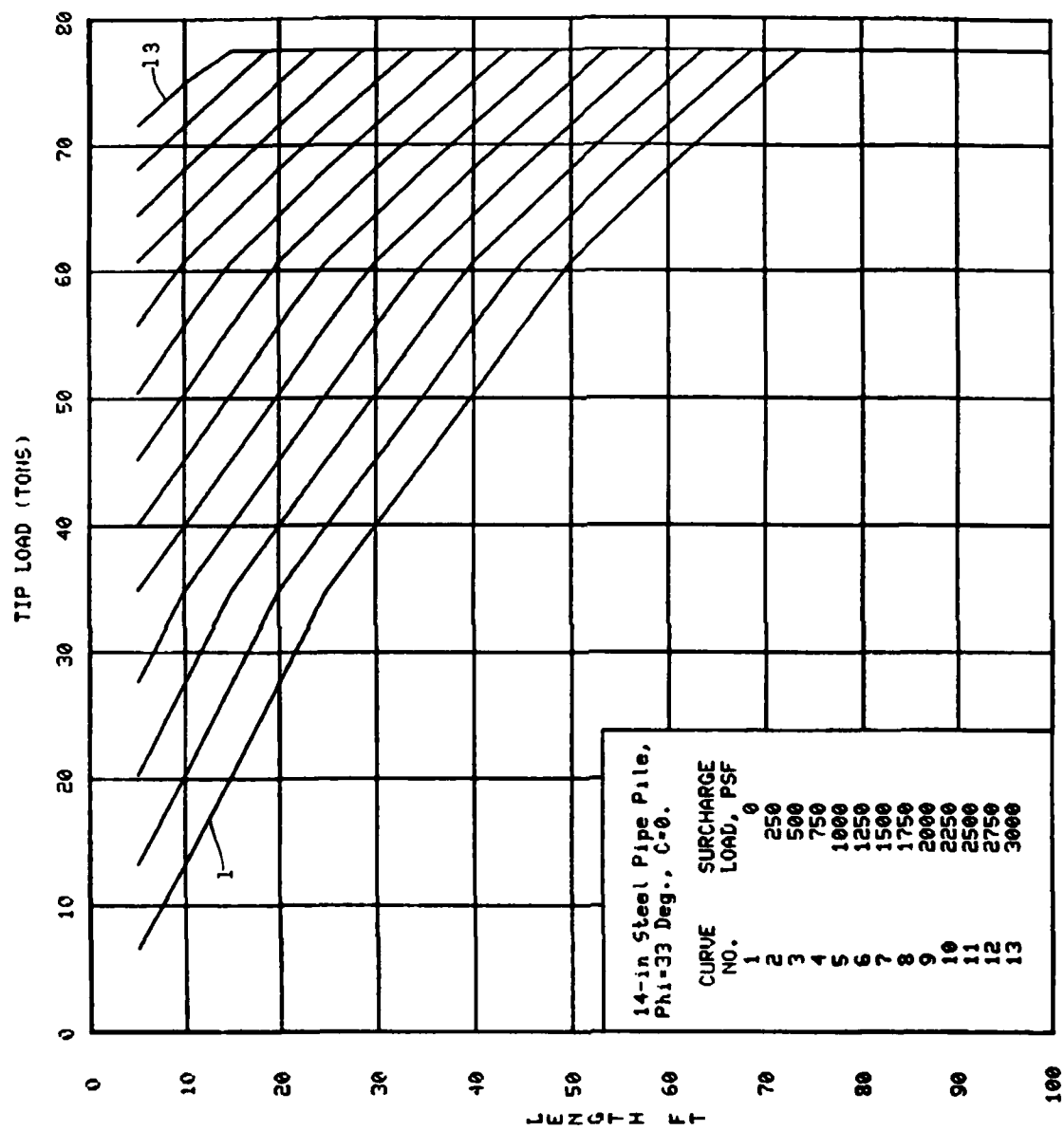


Figure 80. Tip Capacity For A 14-in Steel Pipe Pile,  
Submerged Condition, 1/4-in. Tip Movement, Phi=33 Deg., C=0.



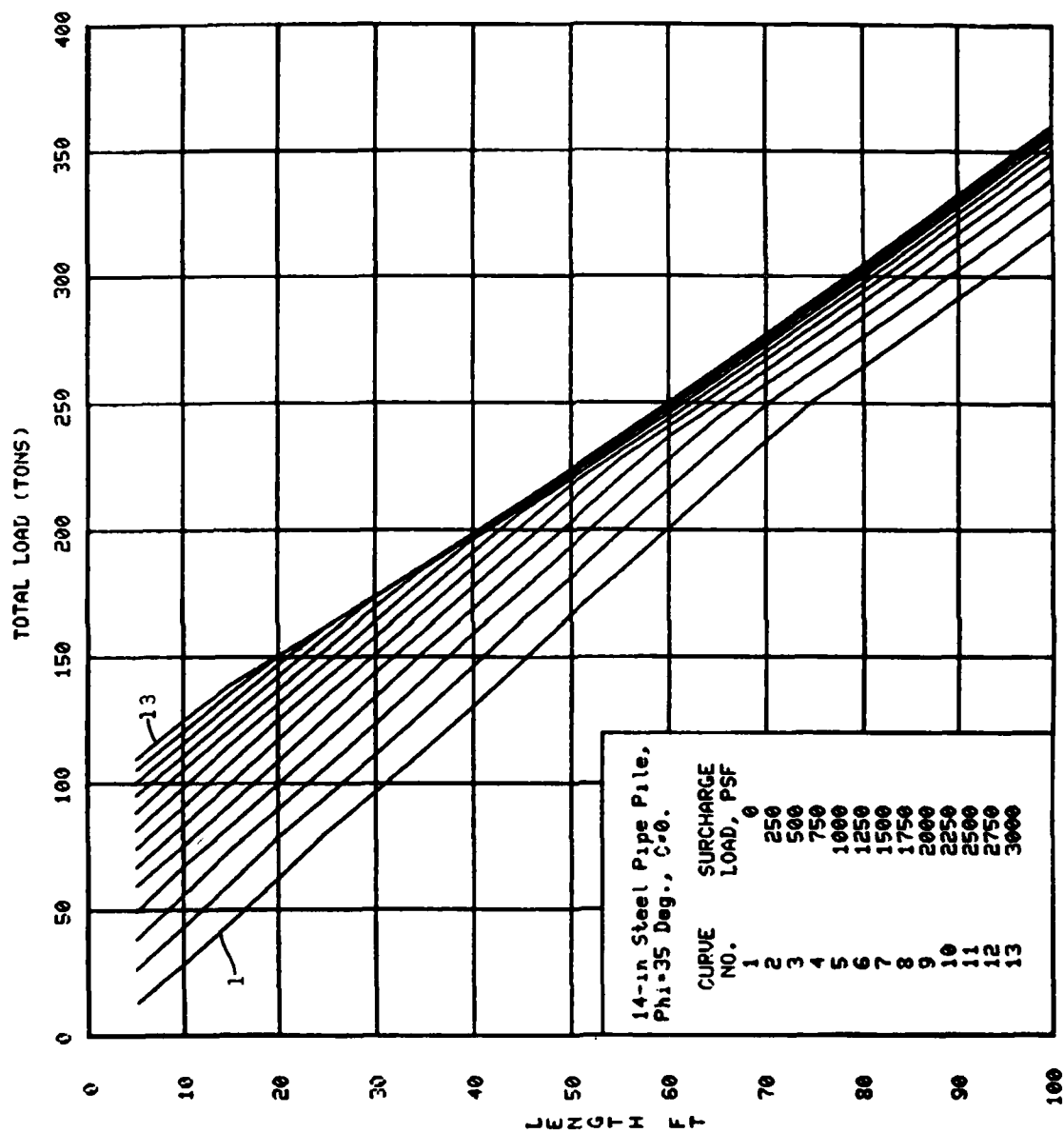


Figure 81. Total Pile Capacity For A 14-in Steel Pipe Pile, Submerged Condition, 1/4-in. Tip Movement, Phi=35 Deg., C=0.



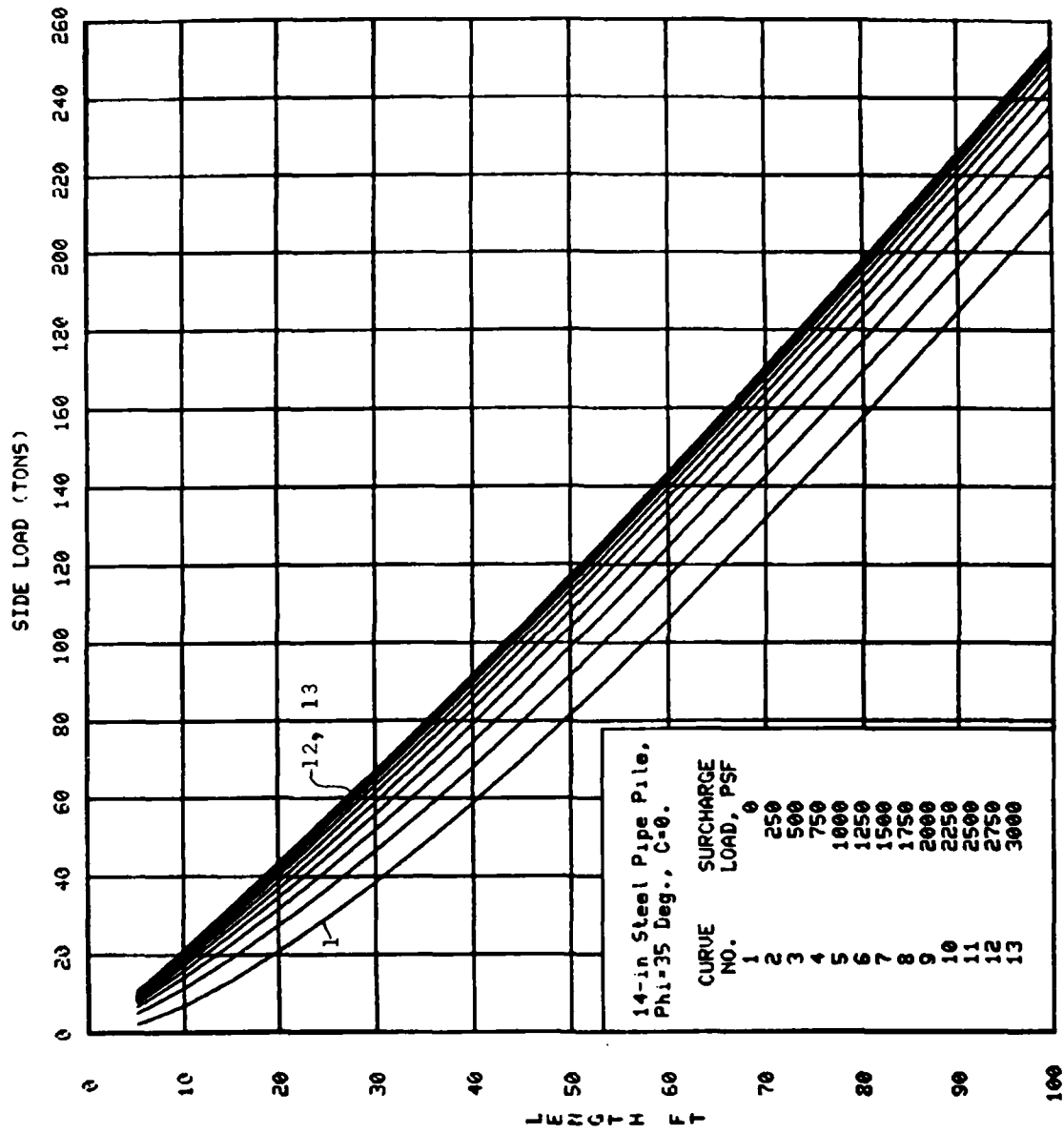


Figure 82. Side Capacity For A 14-in Steel Pipe Pile,  
Submerged Condition, 1/4-in. Tip Movement, Phi=35 Deg., C=0.



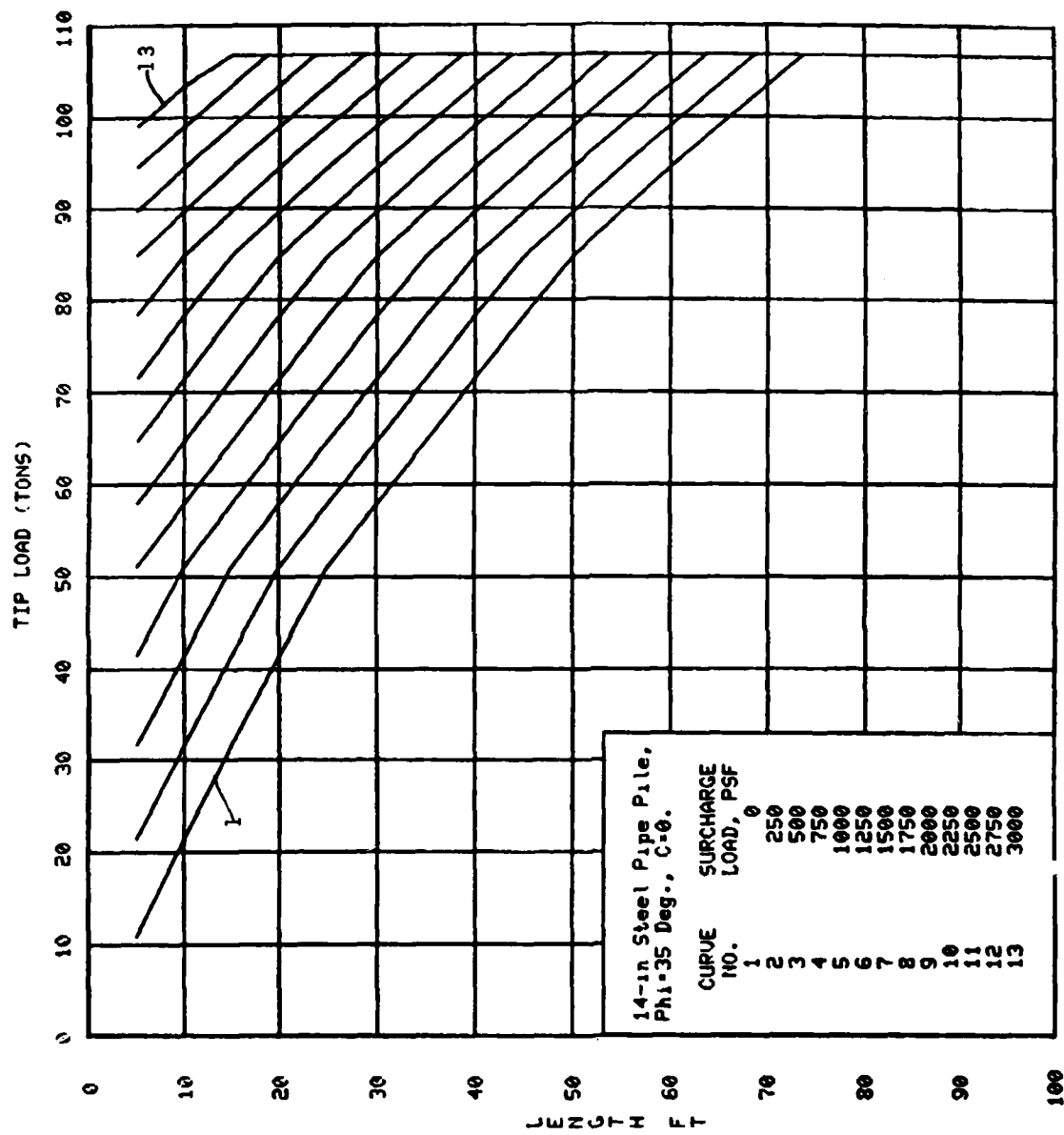


Figure 83. Tip Capacity For A 14-in Steel Pipe Pile, Submerged Condition, 1/4-in. Tip Movement, Phi=35 Deg., C=0.



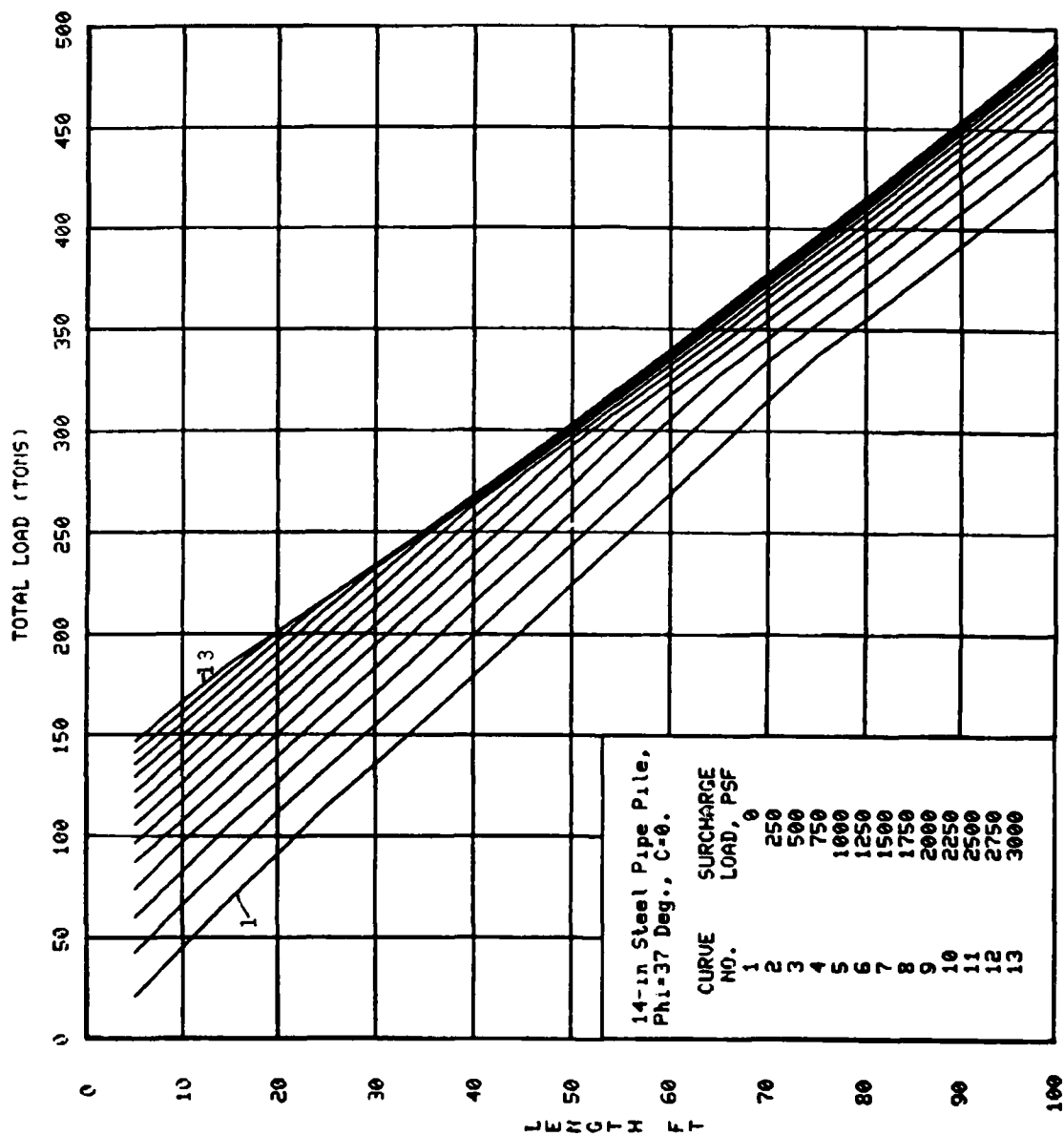


Figure 84. Total Pile Capacity For A 14-in Steel Pipe Pile,  
Submerged Condition, 1/4-in. Tip Movement, Phi=37 Deg., C=0.



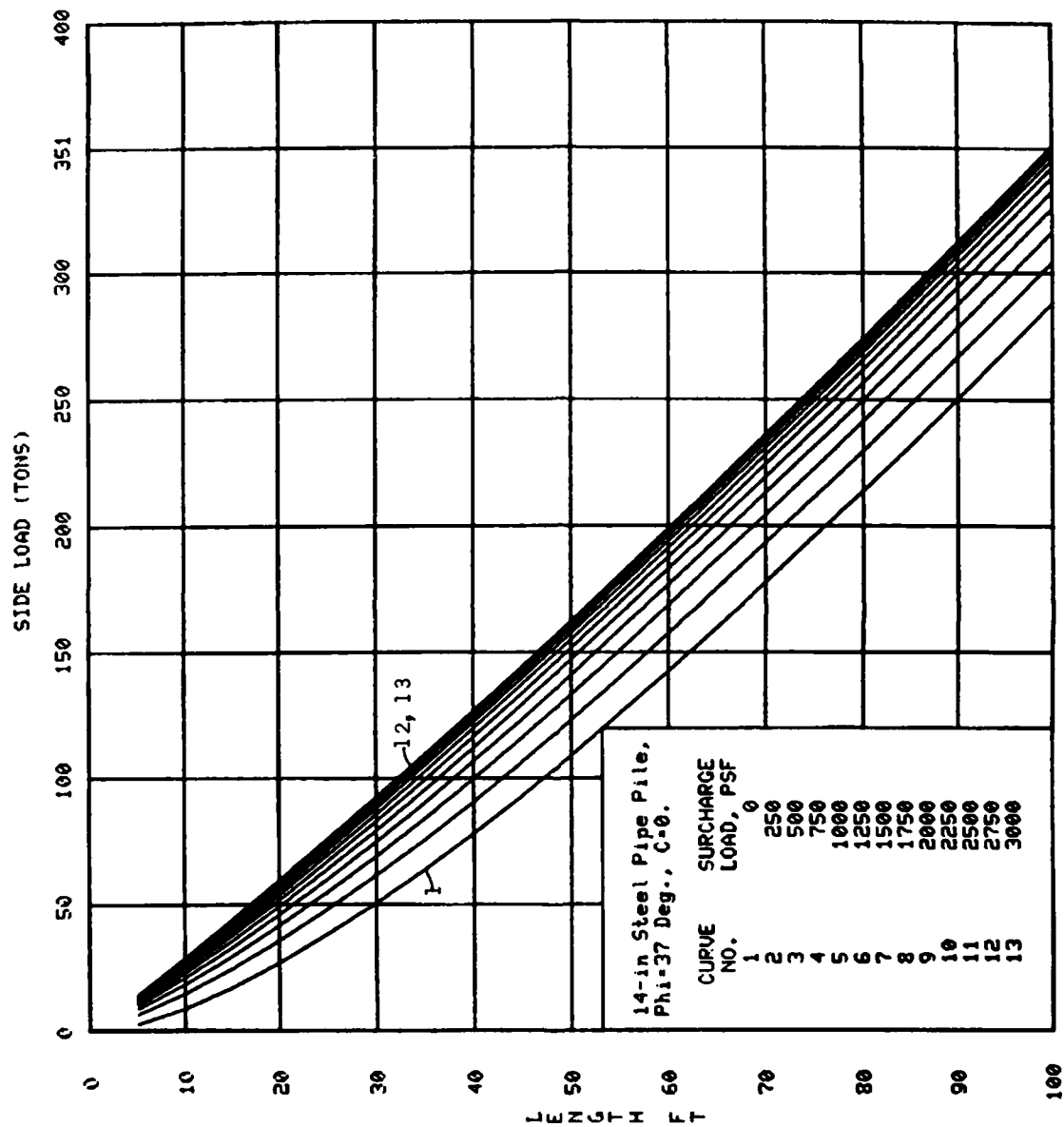


Figure 85. Side Capacity For A 14-in Steel Pipe Pile, Submerged Condition, 1/4-in. Tip Movement, Phi=37 Deg., C=0.



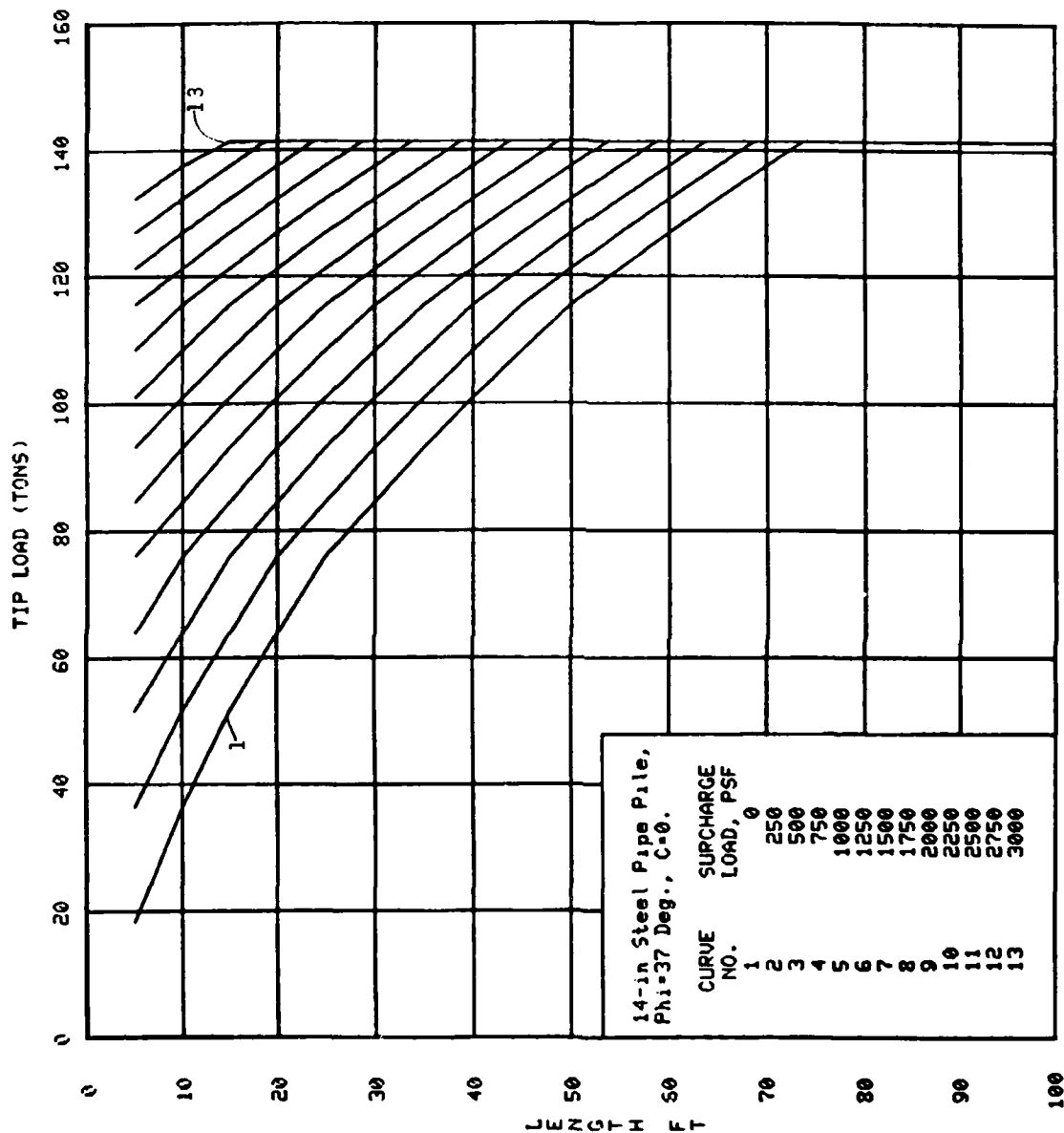


Figure 86. Tip Capacity For A 14-in Steel Pipe Pile,  
Submerged Condition, 1/4-in. Tip Movement, Phi=37 Deg., C=0.



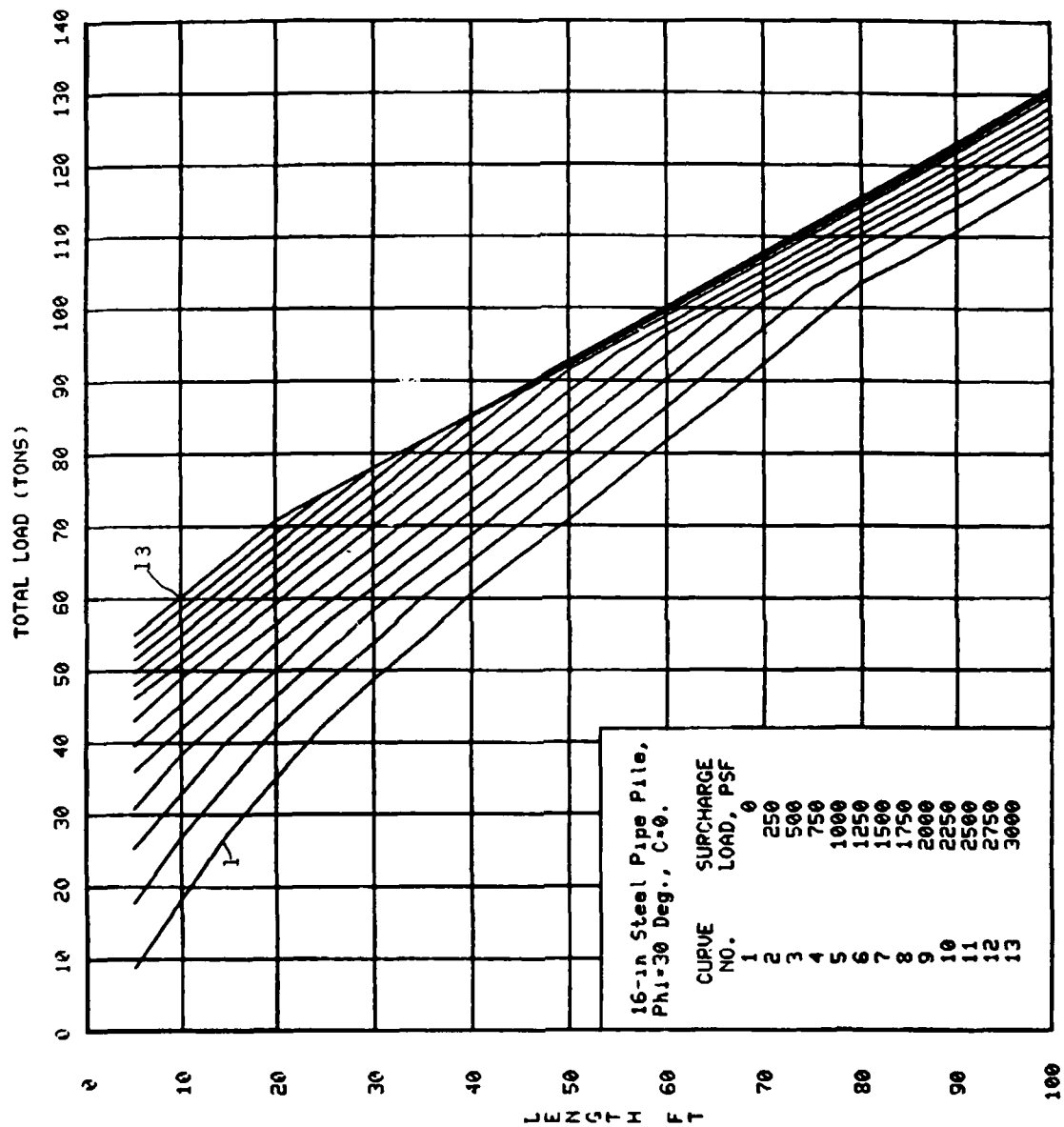


Figure 87. Total Pile Capacity For A 16-in Steel Pipe Pile, Submerged Condition, 1/4-in. Tip Movement, Phi=30 Deg., C=0.



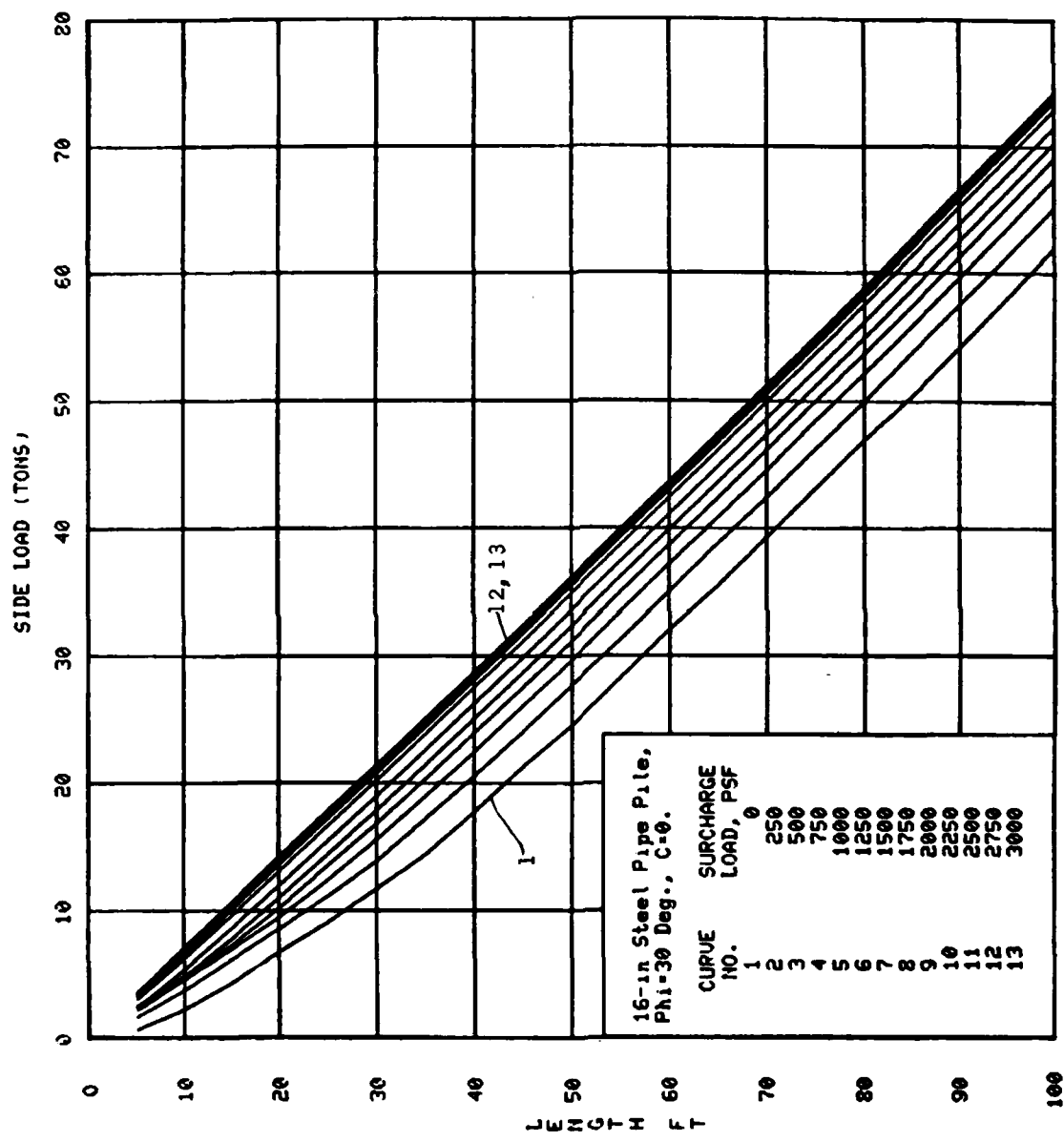


Figure 88. Side Capacity For A 16-in Steel Pipe Pile, Submerged Condition, 1/4-in. Tip Movement, Phi=30 Deg., C=0.



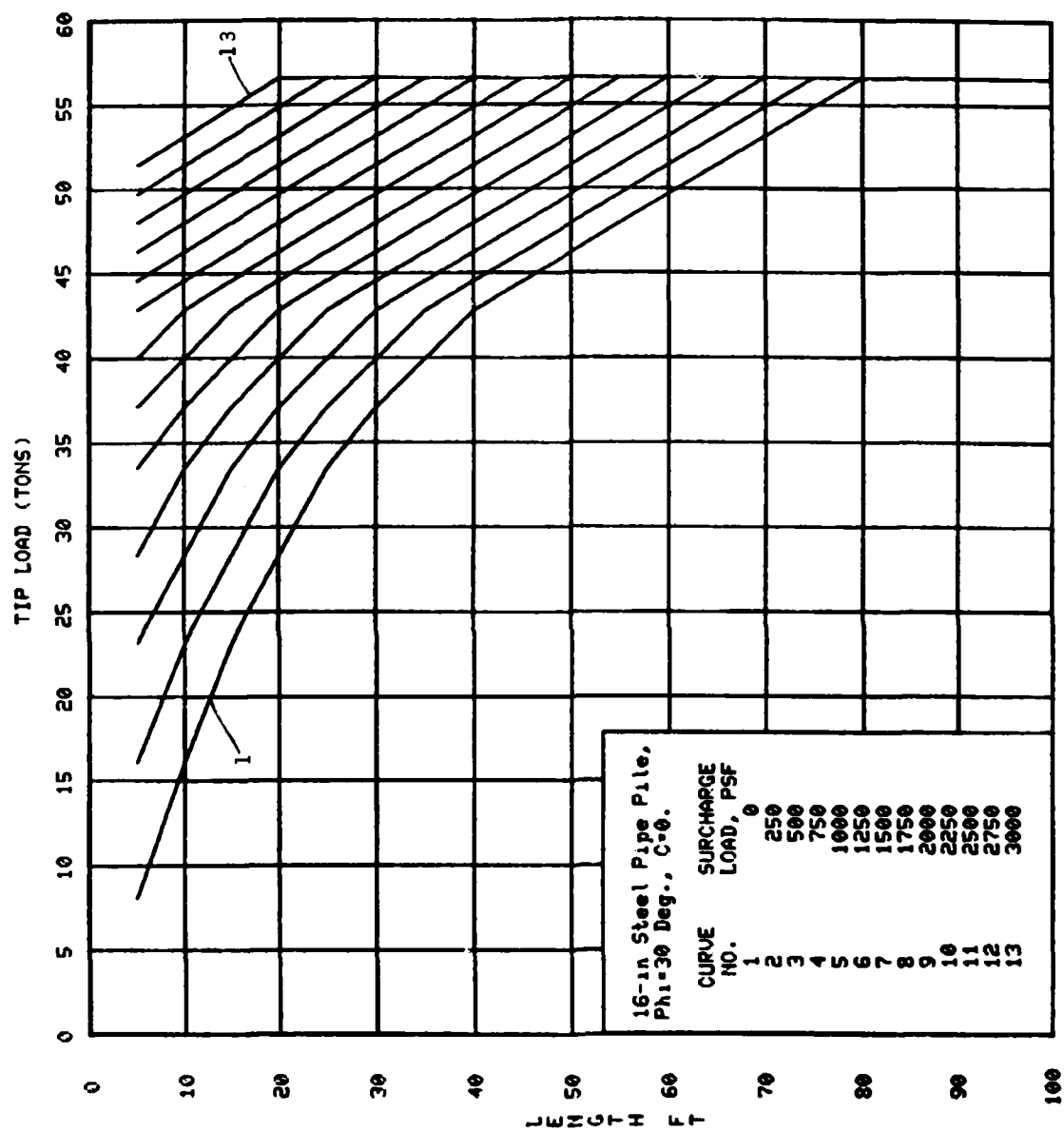


Figure 89. Tip Capacity For A 16-in Steel Pipe Pile, Submerged Condition, 1/4-in. Tip Movement, Phi=30 Deg., C=0.



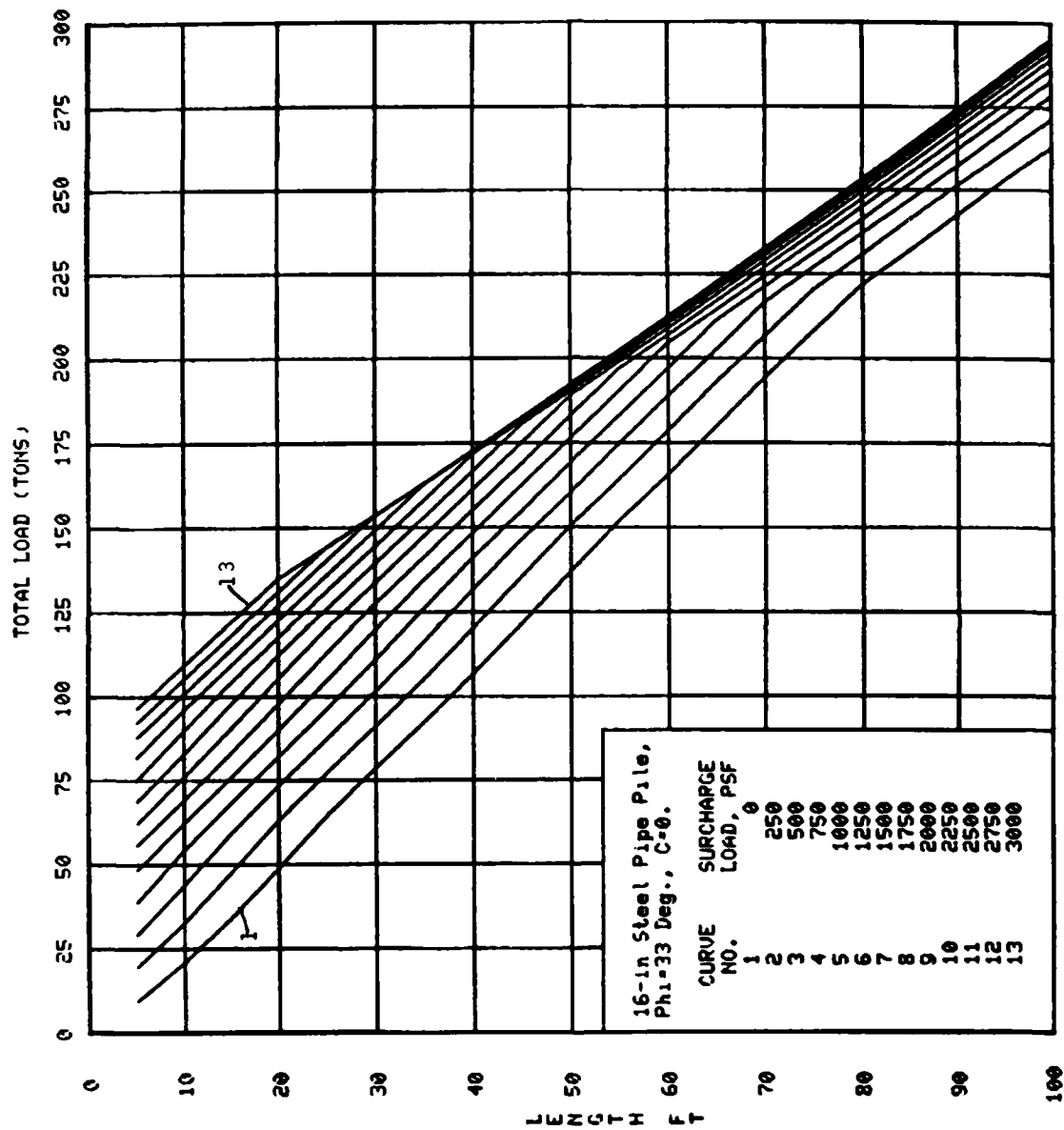


Figure 90. Total Pile Capacity For A 16-in Steel Pipe Pile, Submerged Condition, 1/4-in. Tip Movement, Phi=33 Deg., C=0.



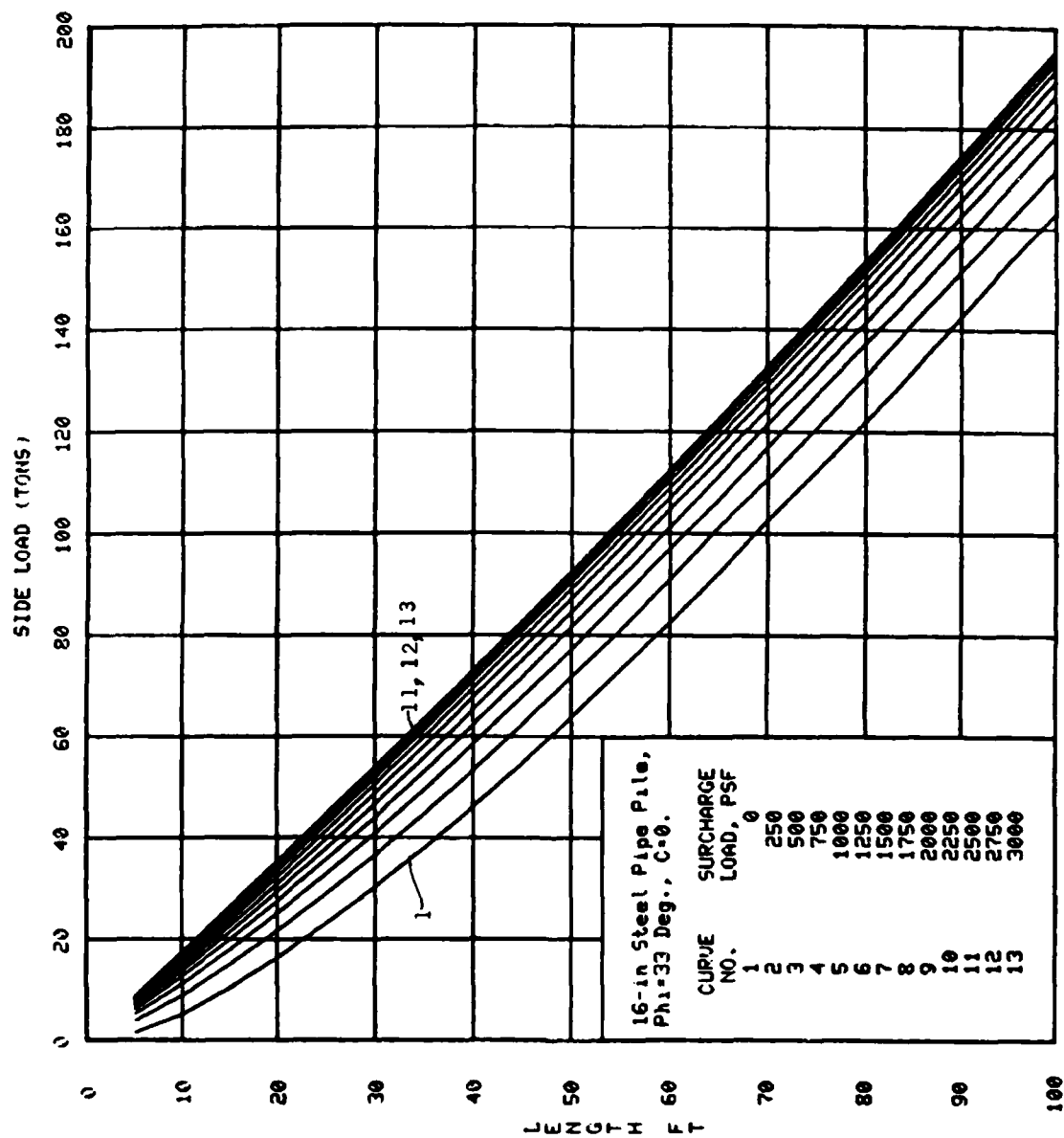


Figure 91. Side Capacity For A 16-in Steel Pipe Pile, Submerged Condition, 1/4-in. Tip Movement, Phi=33 Deg., C=0.



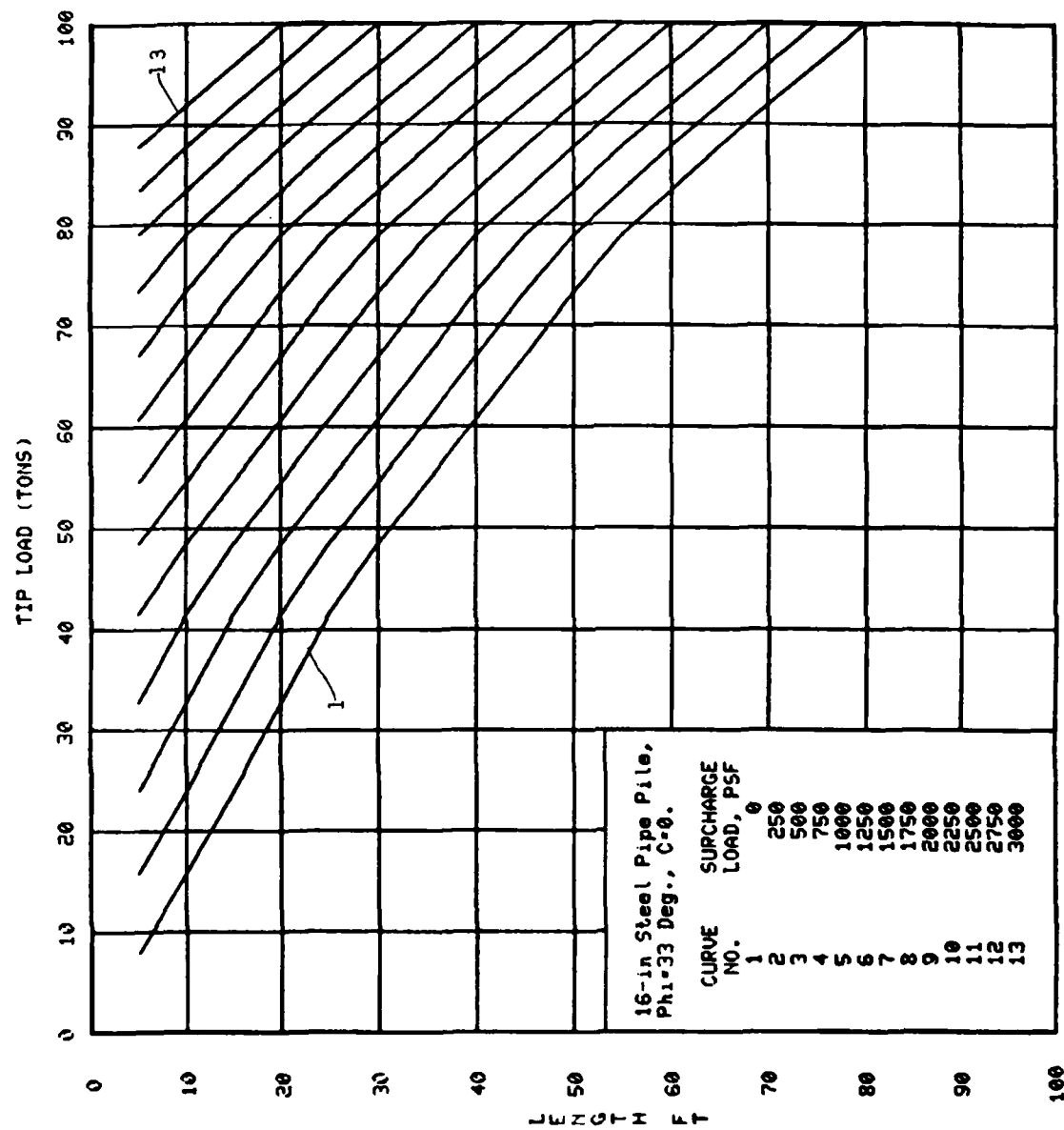


Figure 92. Tip Capacity For A 16-in Steel Pipe Pile,  
 Submerged Condition,  $1/4$ -in. Tip Movement,  $\Phi=33^\circ$  Deg.,  $C=0$ .



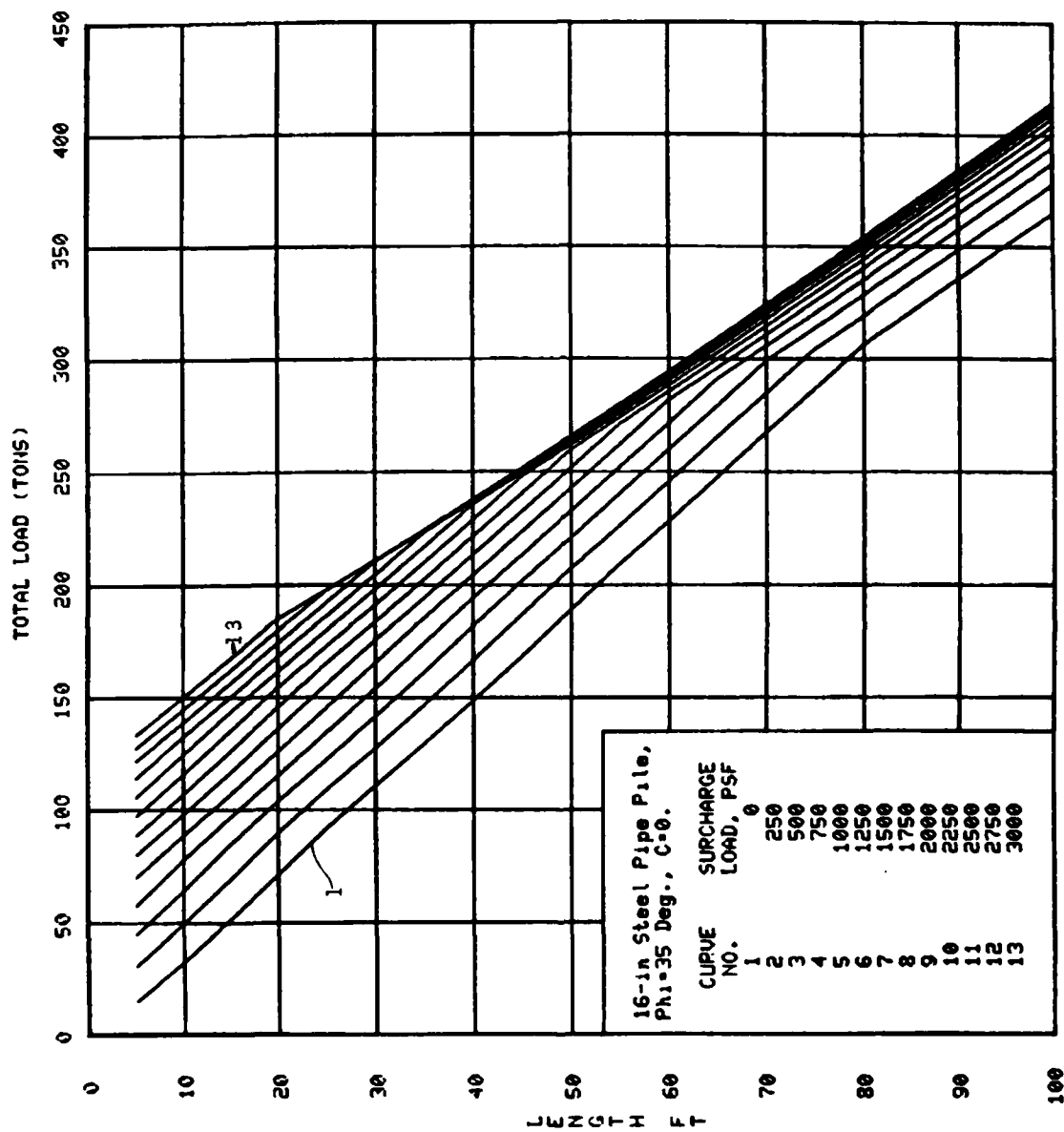


Figure 93. Total Pile Capacity For A 16-in Steel Pipe Pile, Submerged Condition, 1/4-in. Tip Movement, Phi=35 Deg., C=0.



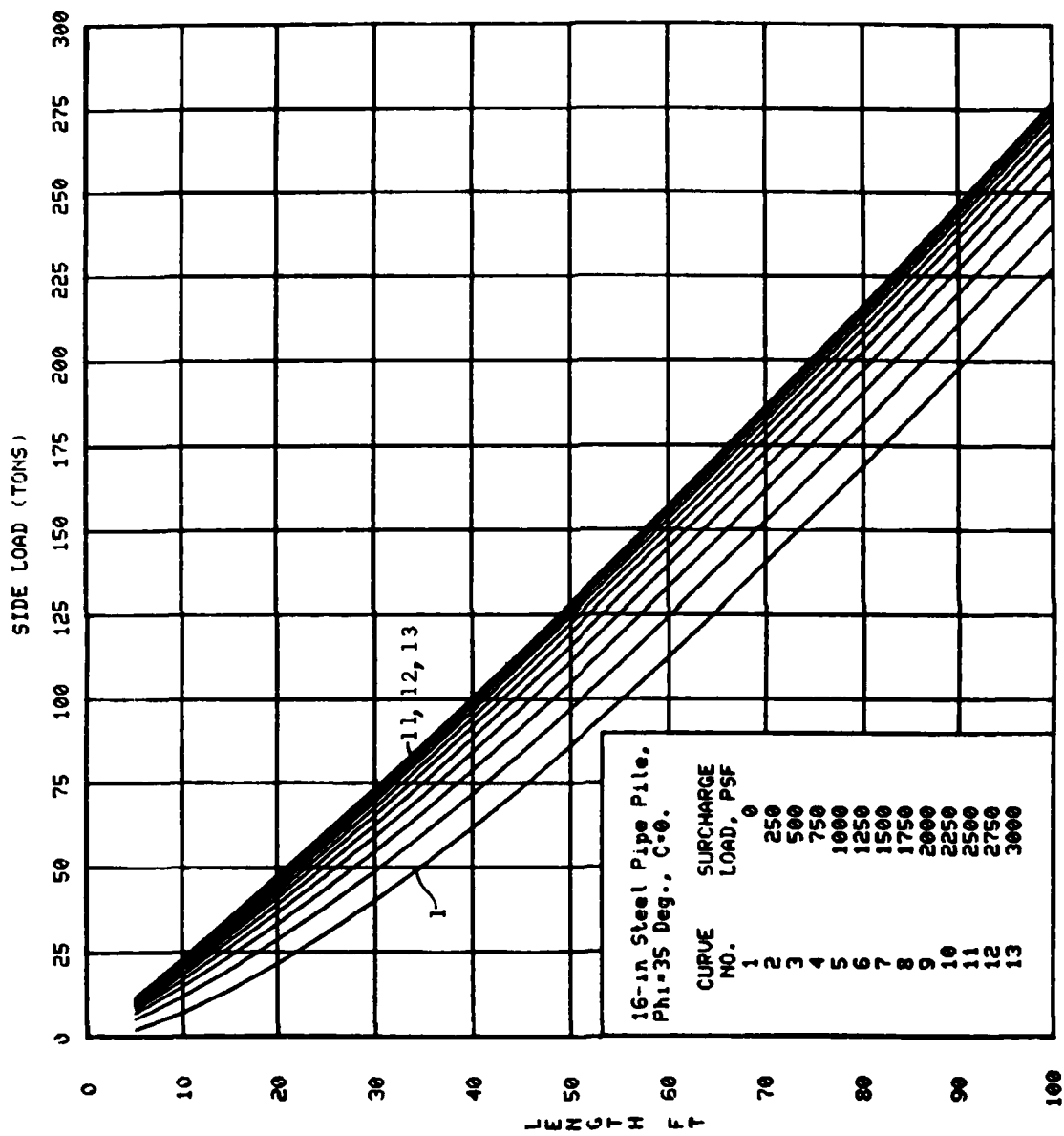


Figure 94. Side Capacity For A 16-in Steel Pipe Pile, Submerged Condition, 1/4-in. Tip Movement, Phi=35 Deg., C=0.



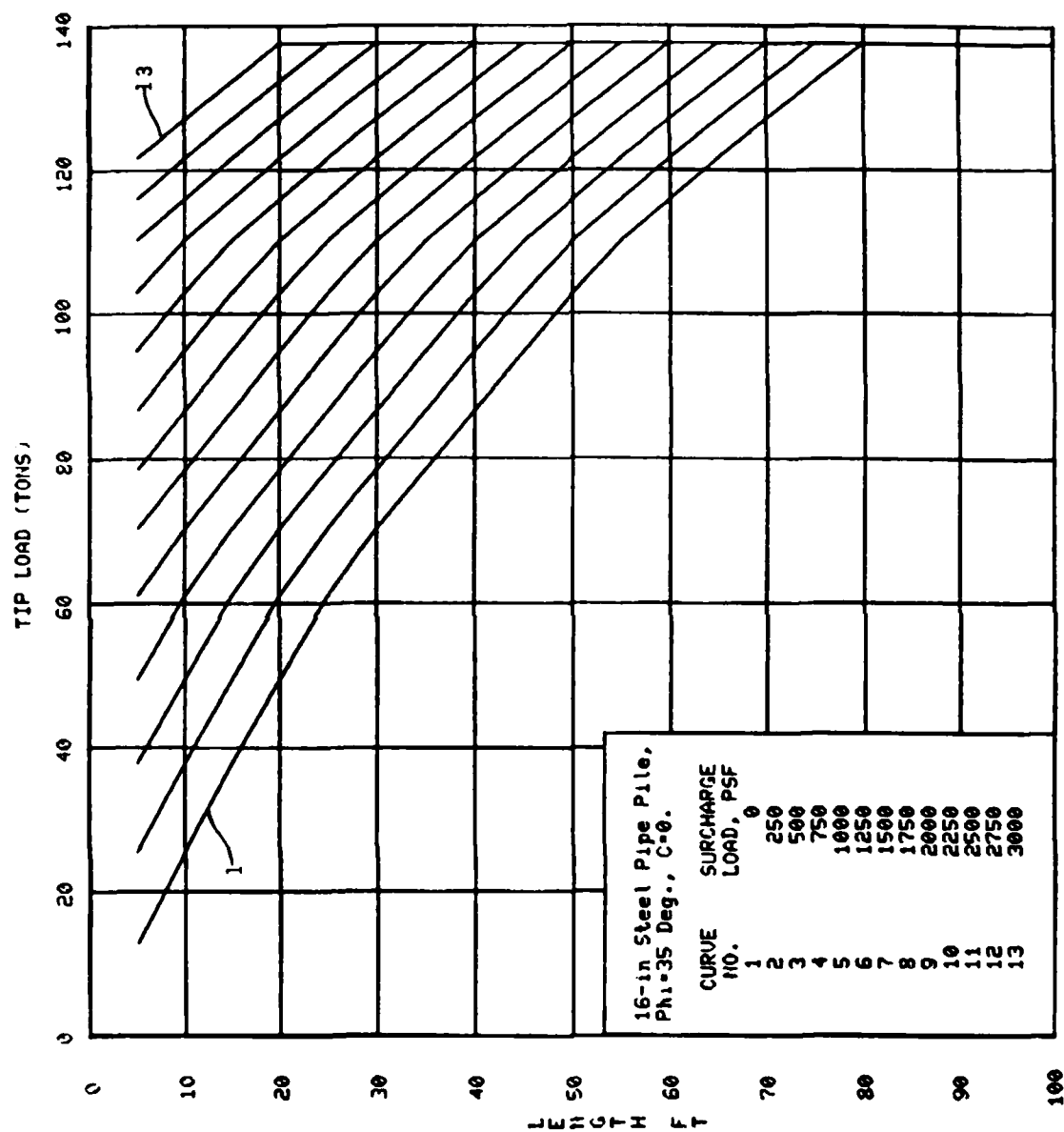


Figure 95. Tip Capacity For A 16-in Steel Pipe Pile,  
Submerged Condition, 1/4-in. Tip Movement, Phi=35 Deg., C=0.



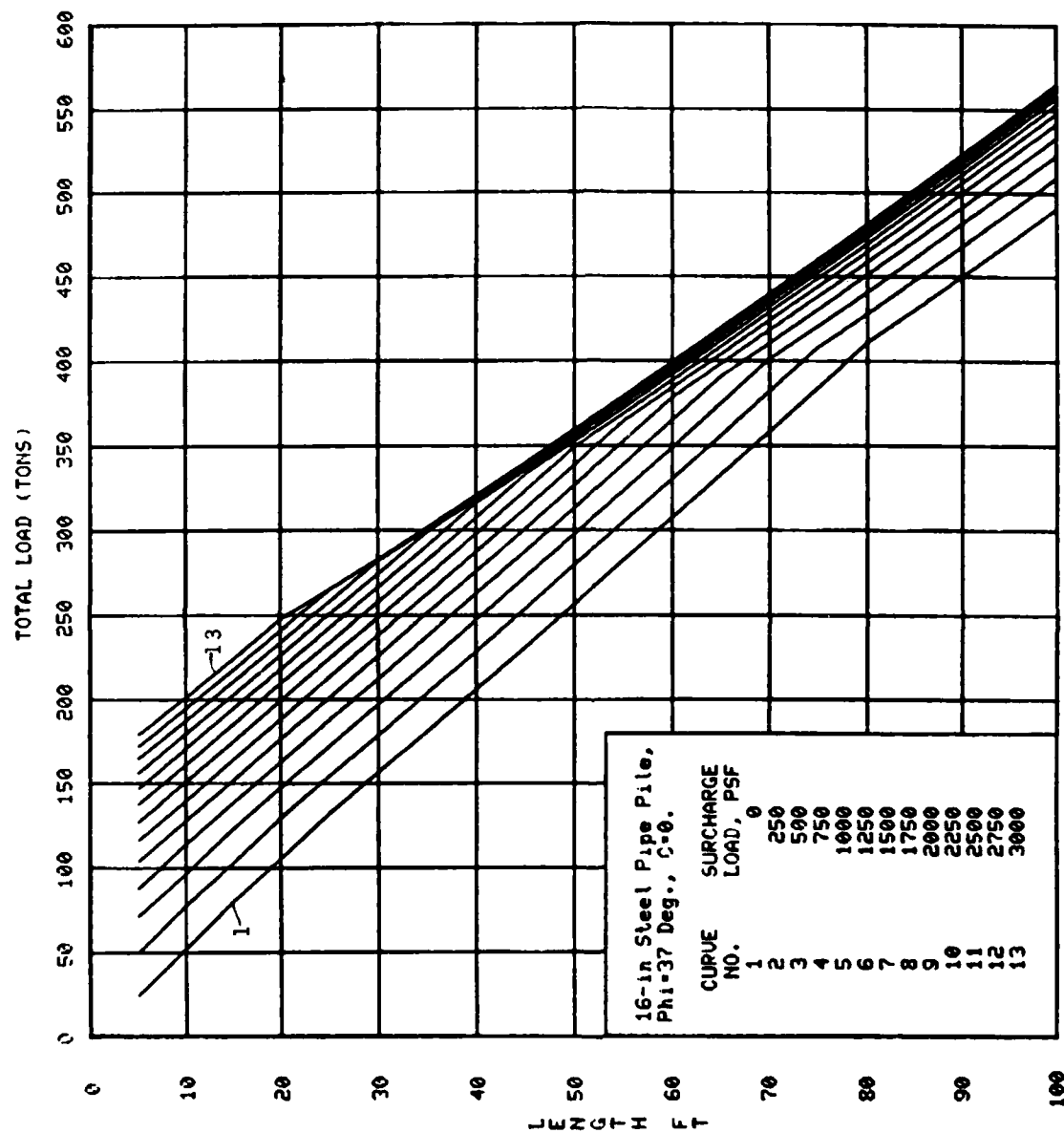


Figure 96. Total Pile Capacity For A 16-in Steel Pipe Pile, Submerged Condition, 1/4-in. Tip Movement, Phi=37 Deg., C=0.



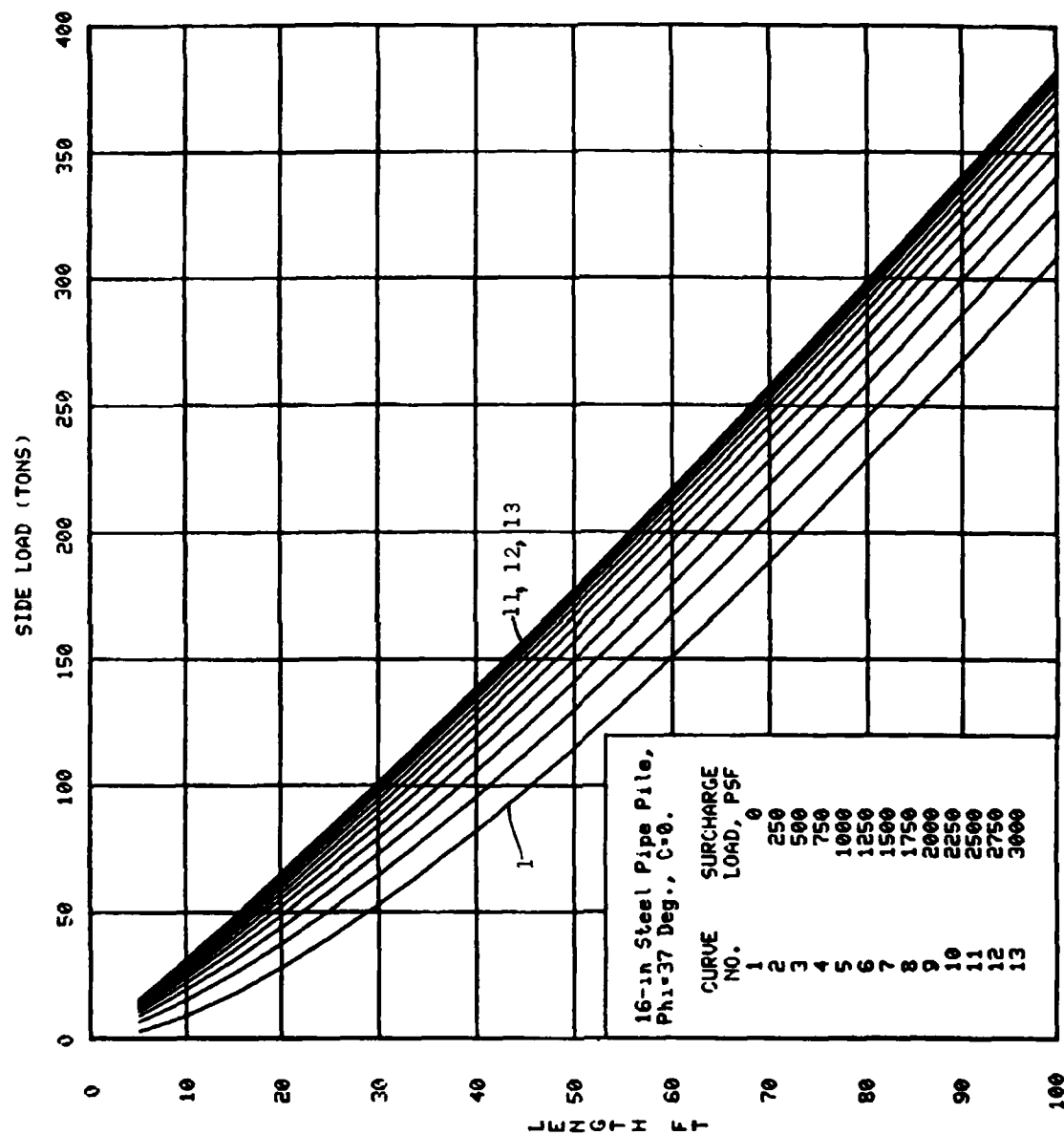


Figure 97. Side Capacity For A 16-in Steel Pipe Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi=37$  Deg.,  $C=0$ .



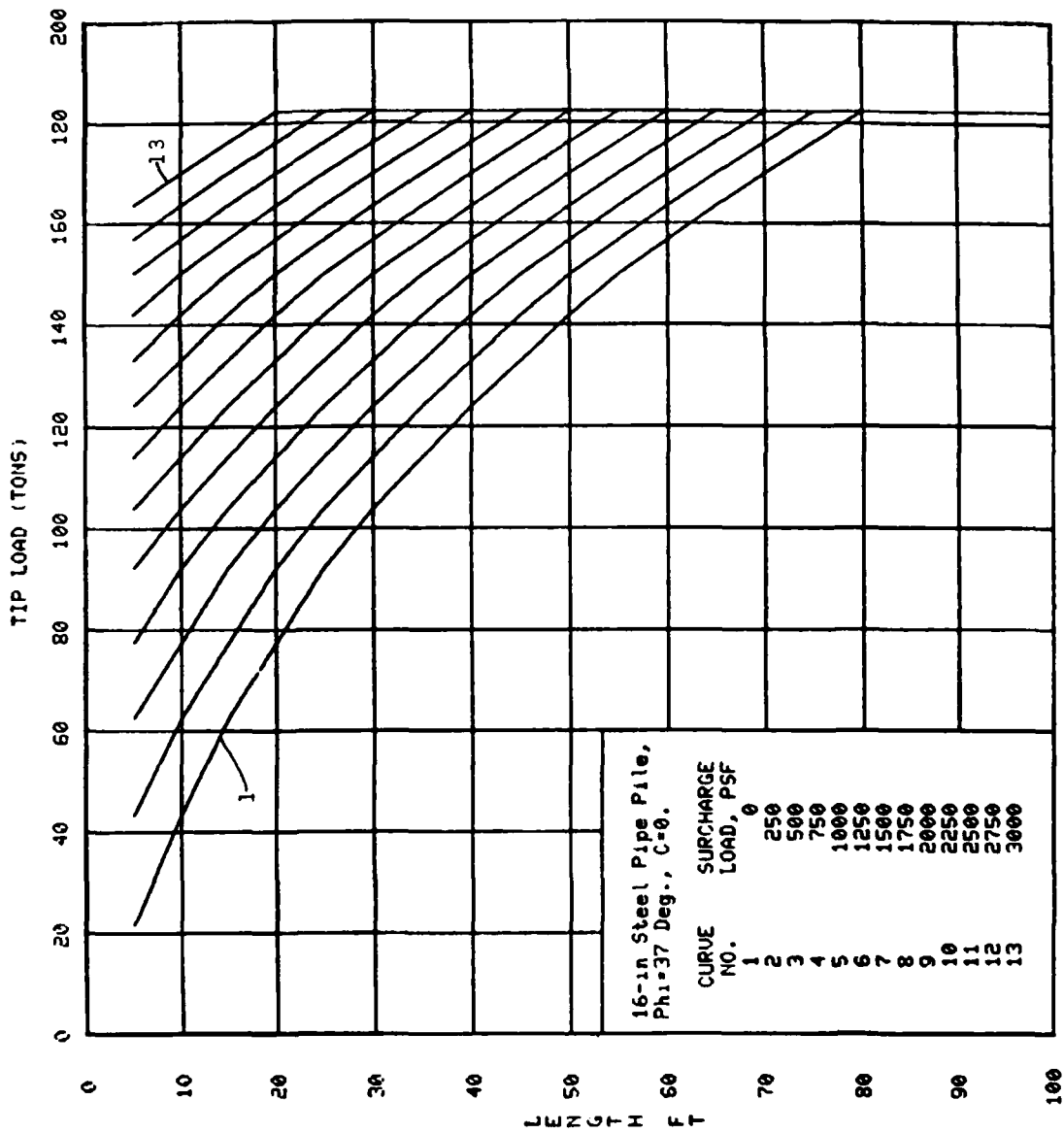


Figure 98. Tip Capacity For A 16-in Steel Pipe Pile,  
 Submerged Condition,  $1/4$ -in. Tip Movement,  $\Phi_1=37$  Deg.,  $C=0$ .



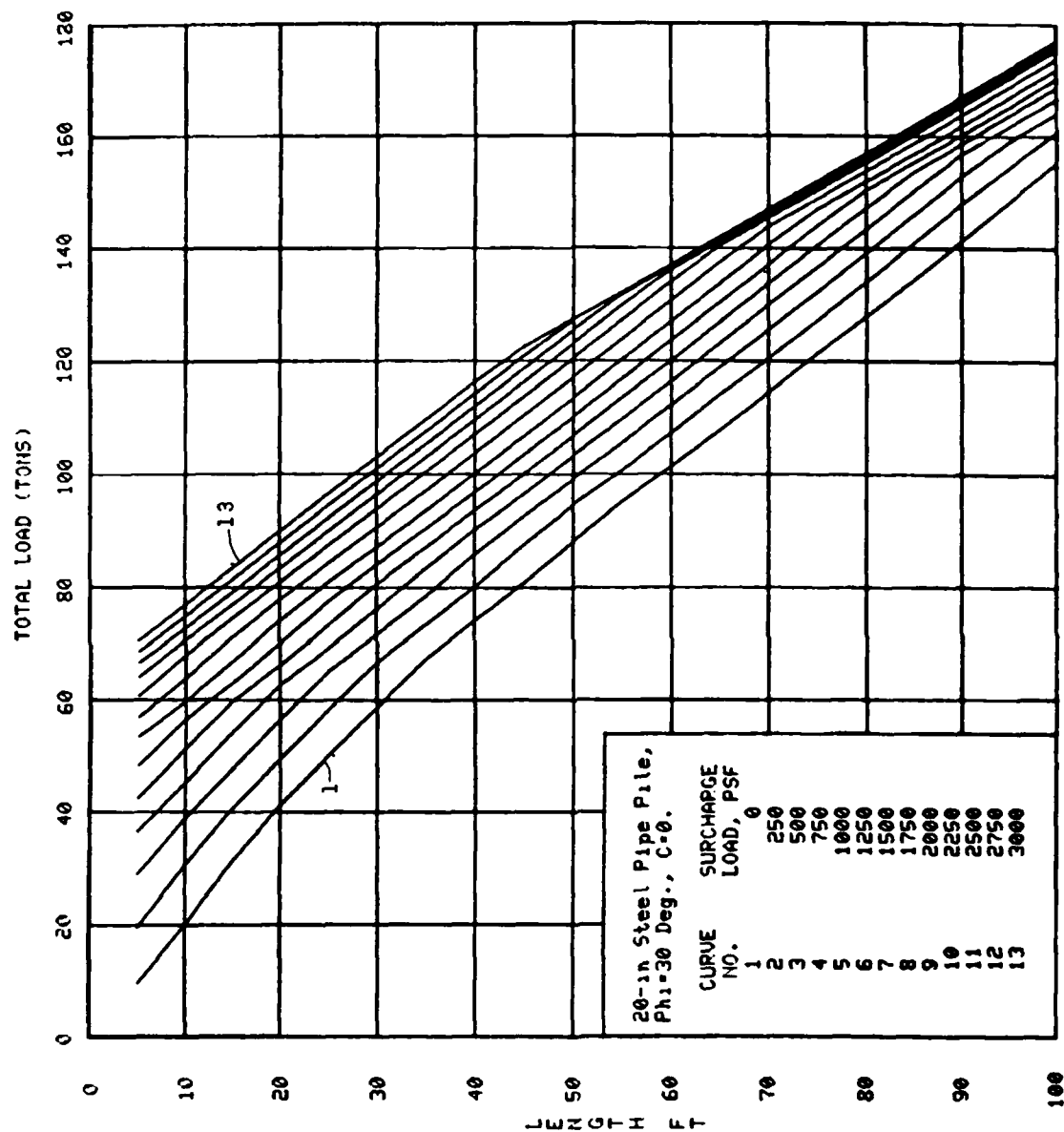


Figure 99. Total Pile Capacity For A 20-in Steel Pipe Pile, Submerged Condition,  $1/4$ -in. Tip Movement,  $\Phi_1=30$  Deg.,  $C=0$ .



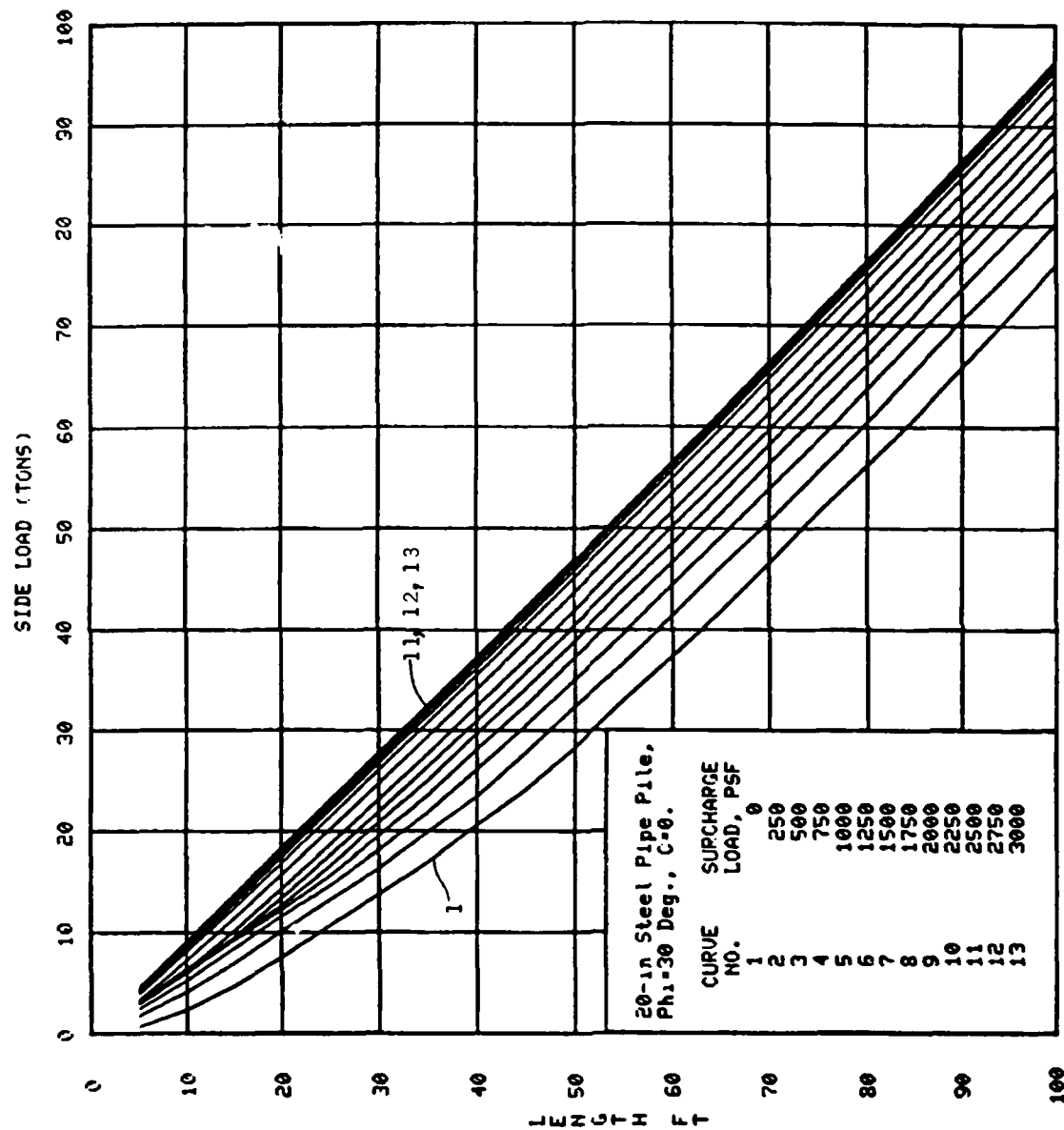


Figure 100. Side Capacity For A 20-in Steel Pipe Pile,  
 Submerged Condition, 1/4-in. Tip Movement,  $\Phi = 30^\circ$  Deg.,  $C = 0$ .



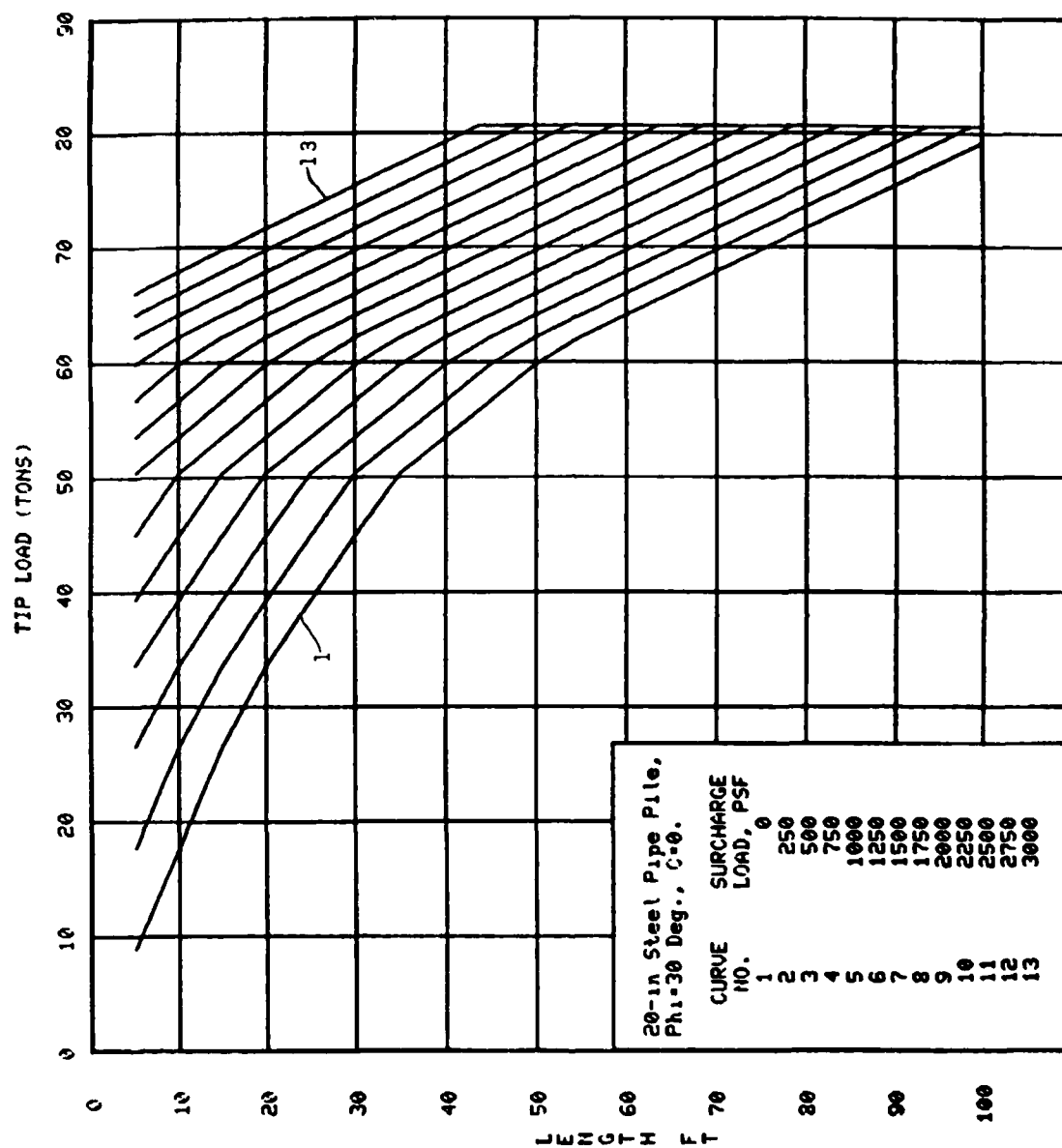


Figure 101. Tip Capacity For A 20-in Steel Pipe Pile,  
 Submerged Condition,  $1/4$ -in. Tip Movement,  $\Phi = 30^\circ$  Deg.,  $C = 0$ .



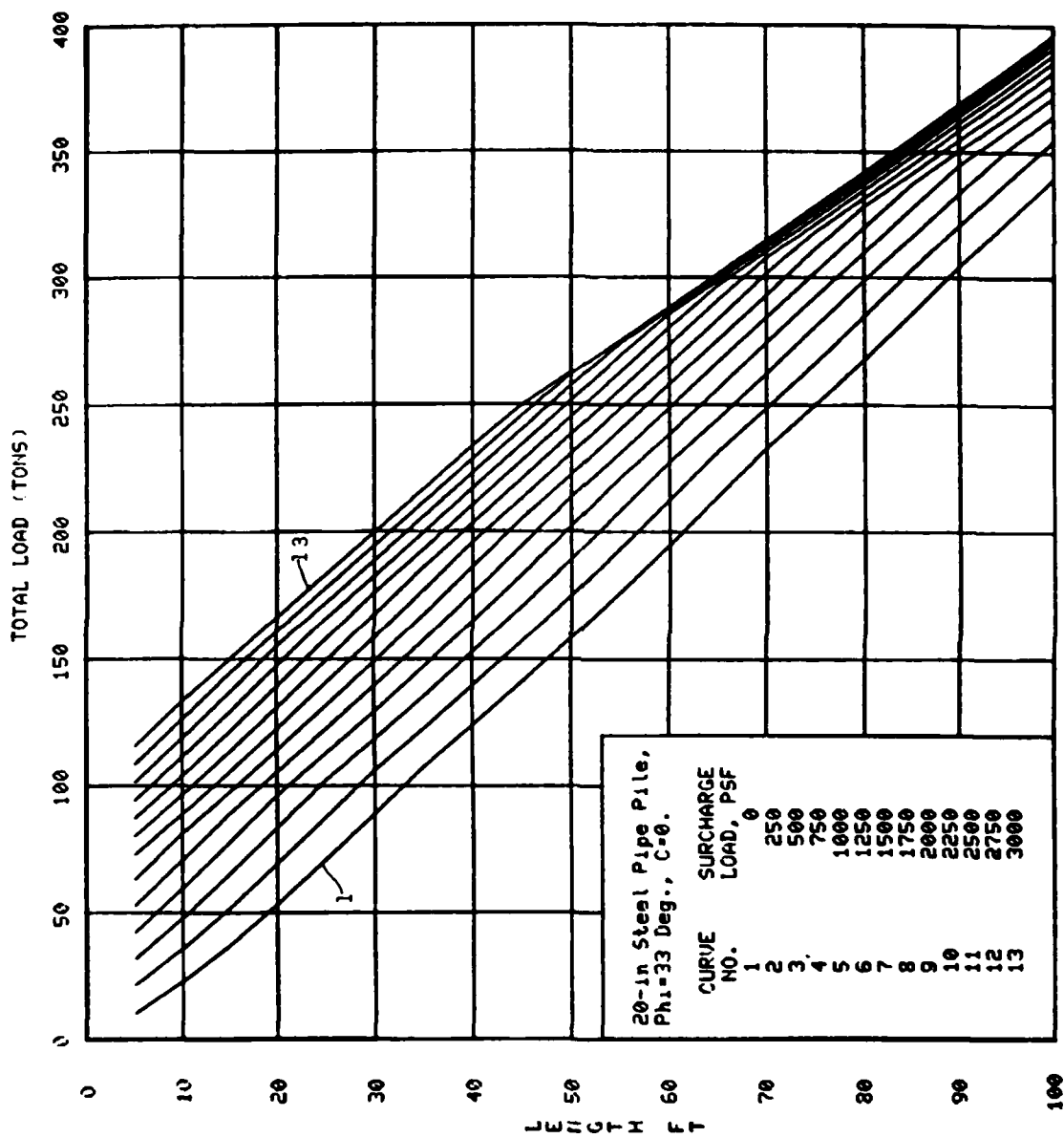


Figure 102. Total Pile Capacity For A 20-in Steel Pipe Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi=33$  Deg.,  $C=0$ .



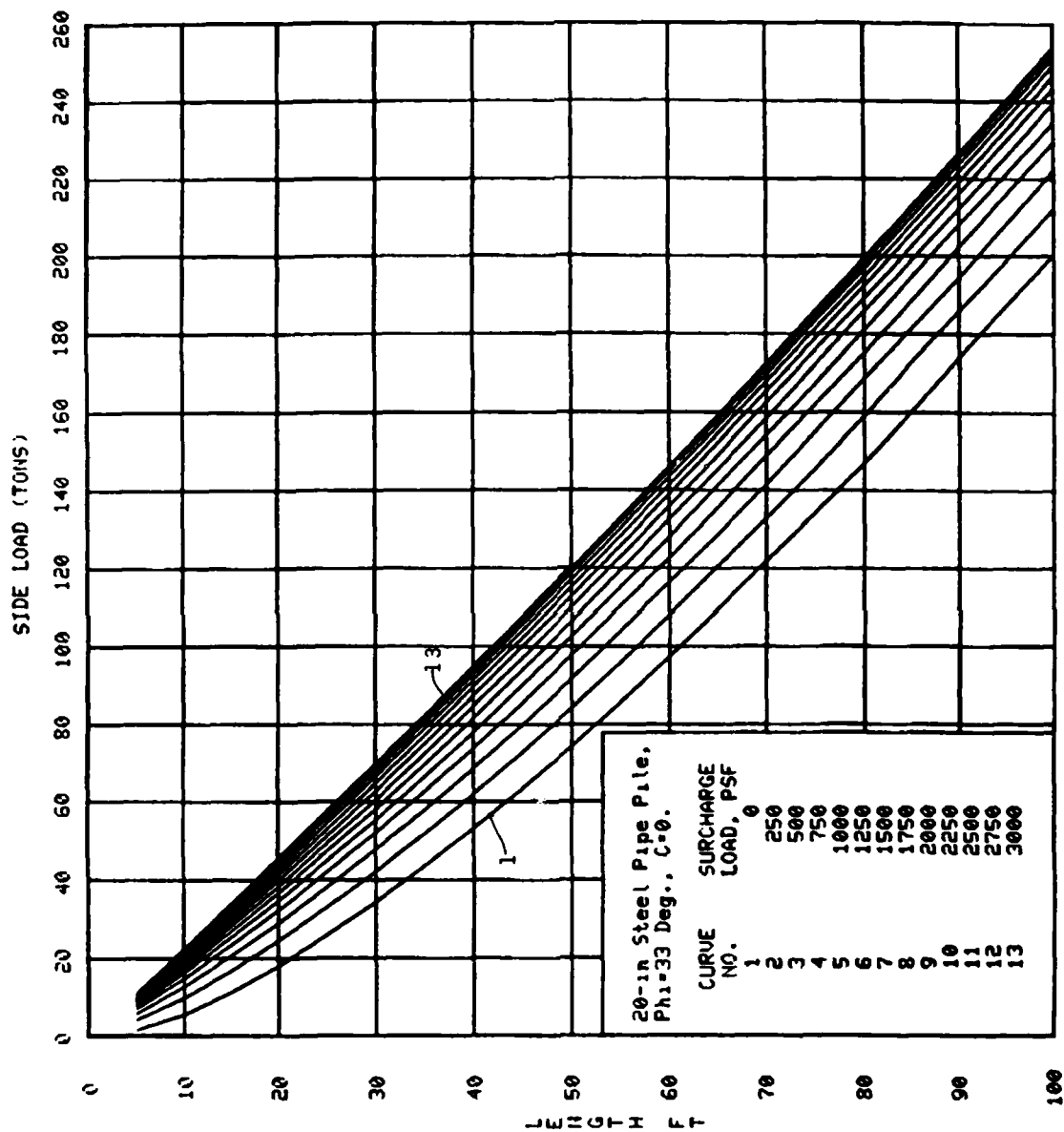


Figure 103. Side Capacity For A 20-in Steel Pipe Pile, Submerged Condition, 1/4-in. Tip Movement, Phi=33 Deg., C=0.



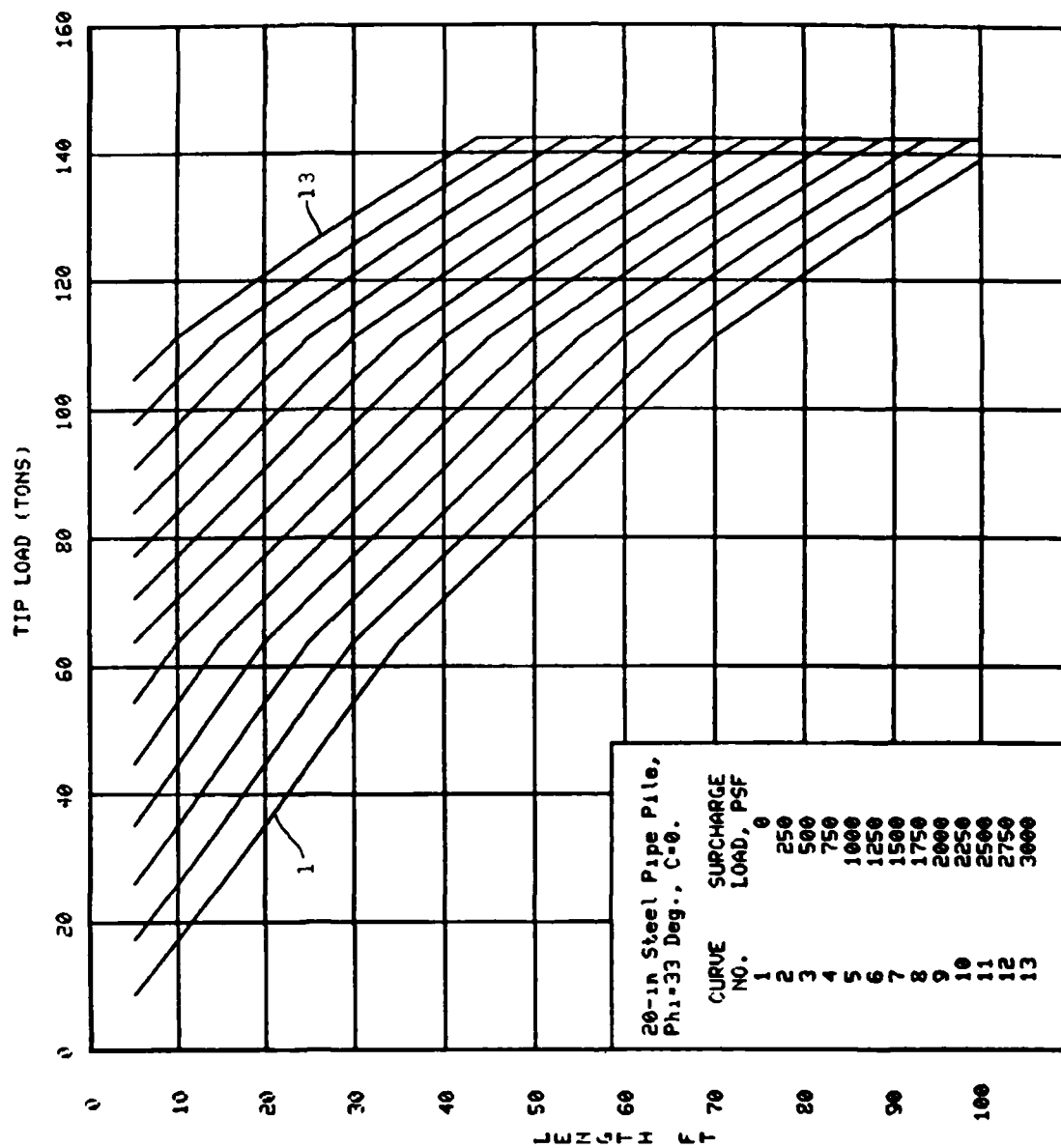


Figure 104. Tip Capacity For A 20-in Steel Pipe Pile, Submerged Condition,  $1/4$ -in. Tip Movement,  $\Phi = 33^\circ$ ,  $C = 0$ .



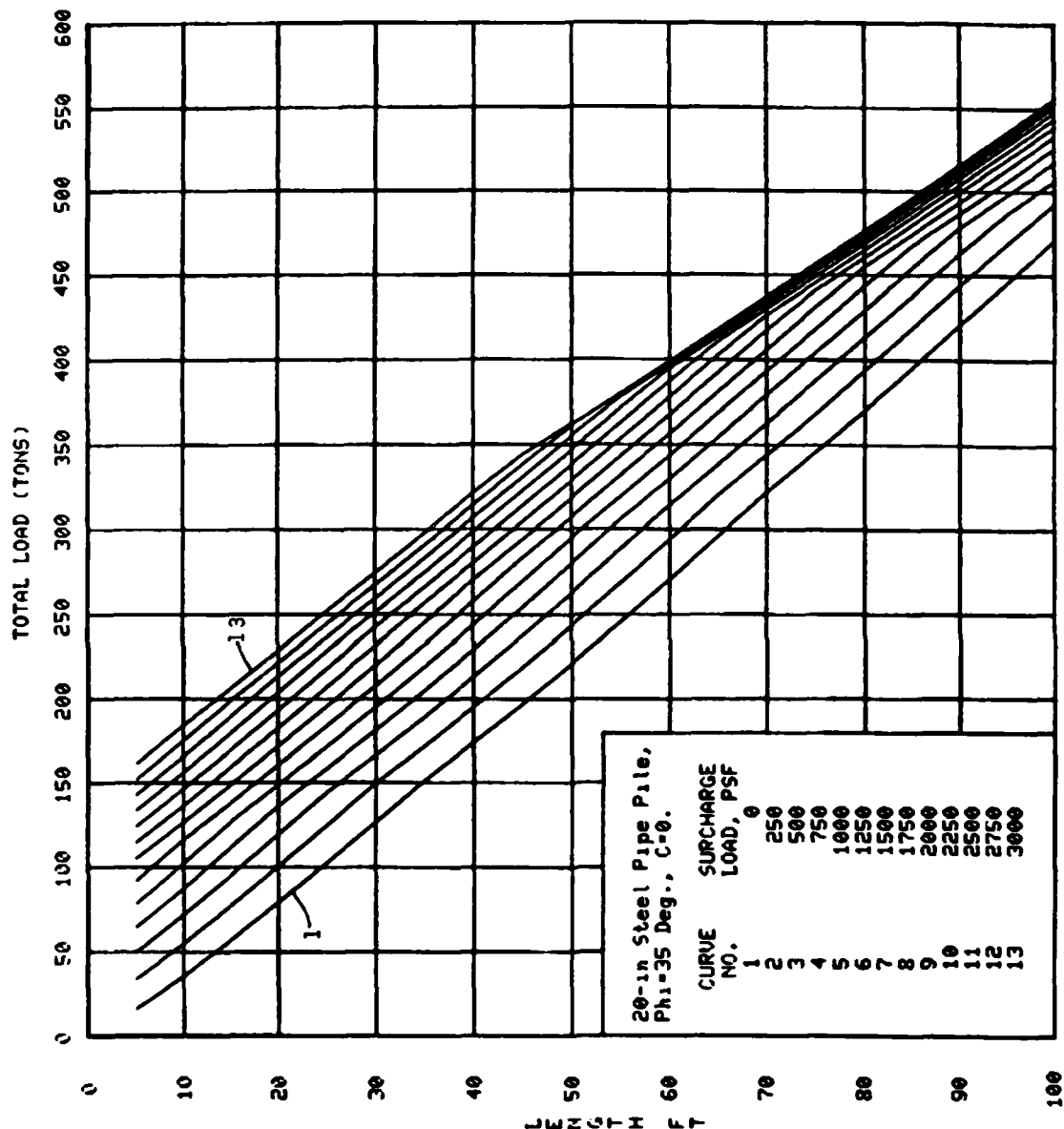


Figure 105. Total Pile Capacity For A 20-in Steel Pipe Pile,  
Submerged Condition, 1/4-in. Tip Movement, Phi=35 Deg., C=0.



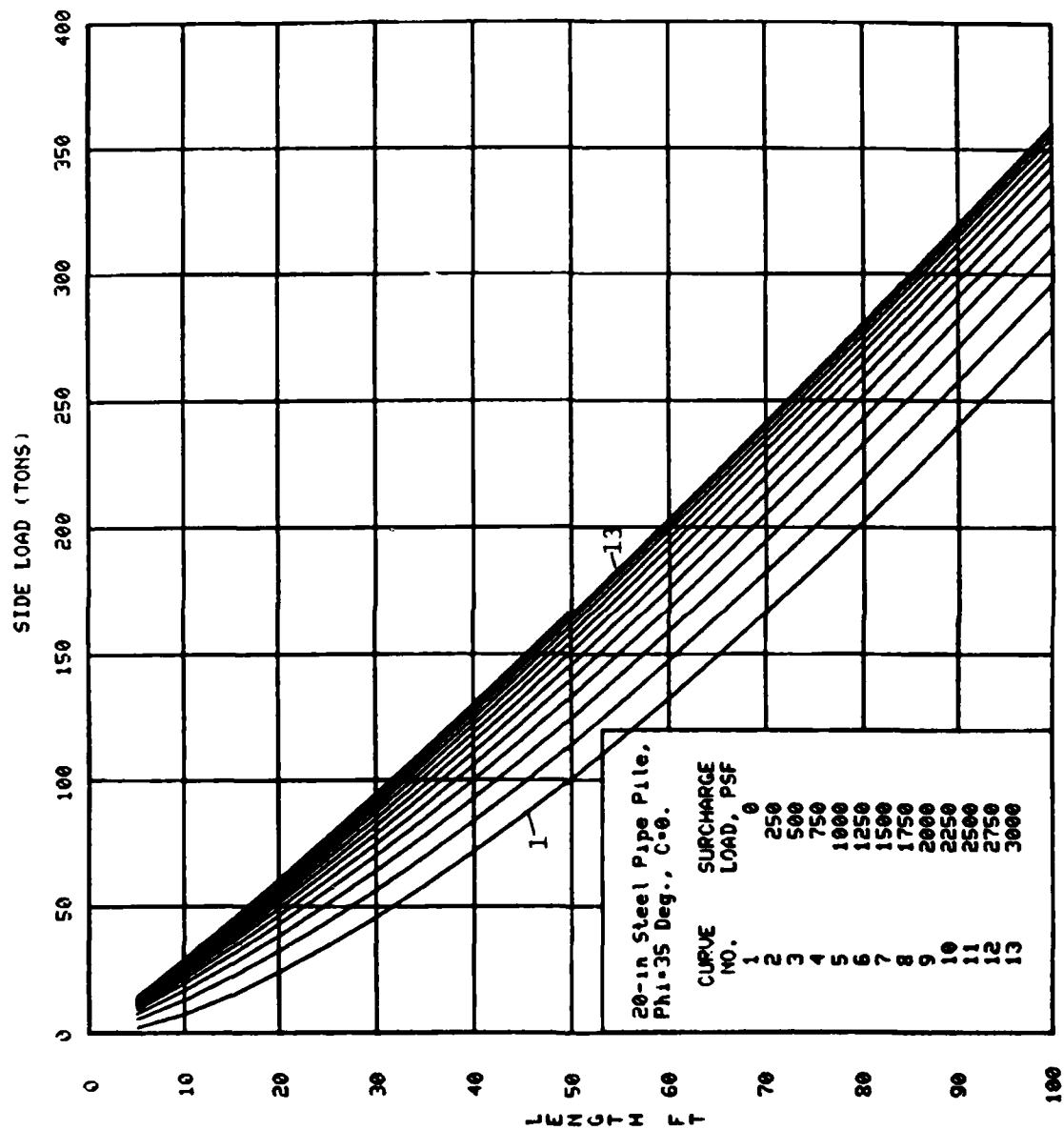


Figure 106. Side Capacity For A 20-in Steel Pipe Pile, Submerged Condition, 1/4-in. Tip Movement, Phi=35 Deg., C=0.



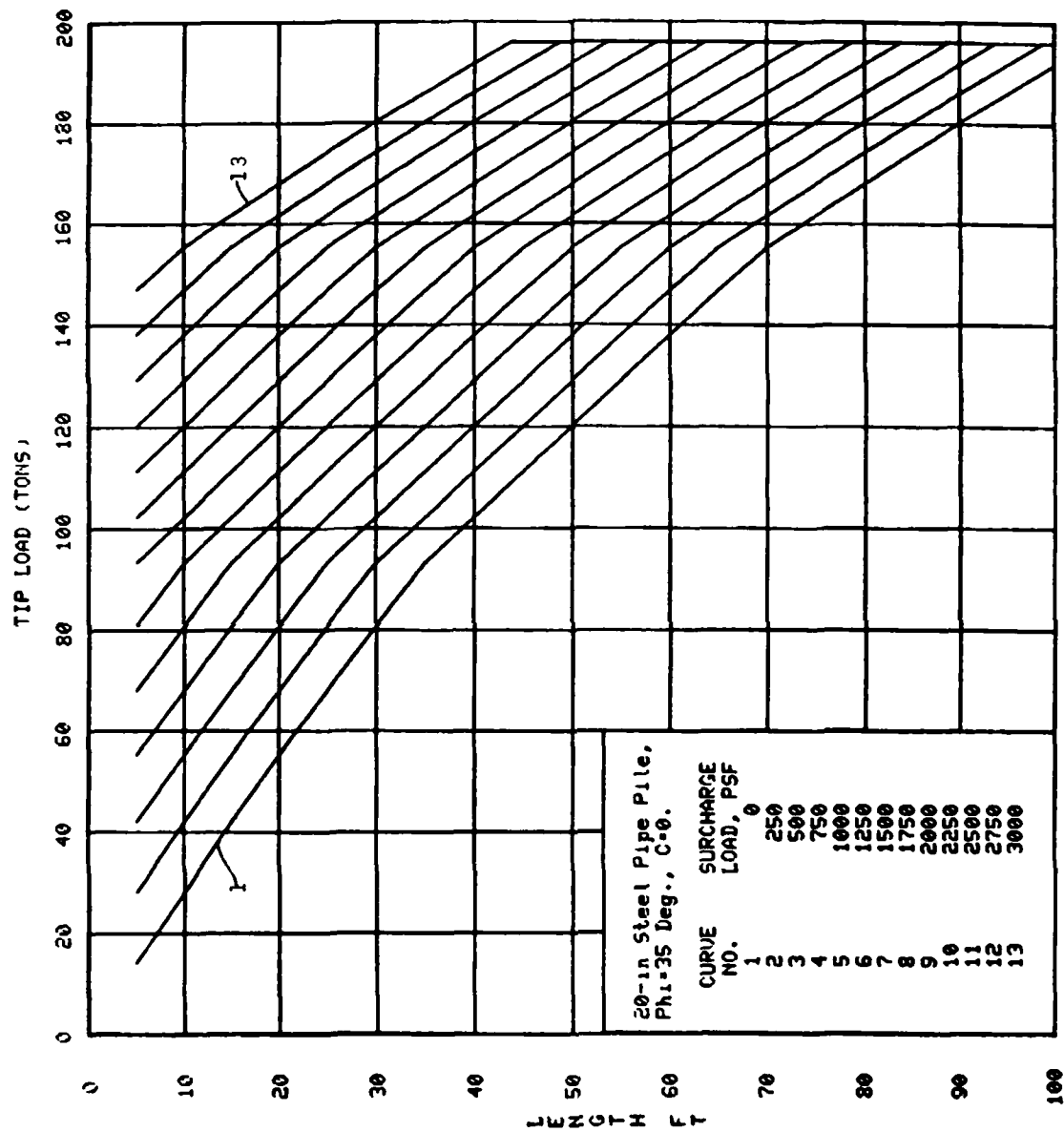


Figure 107. Tip Capacity For A 20-in Steel Pipe Pile,  
Submerged Condition, 1/4-in. Tip Movement, Phi=35 Deg., C=0.



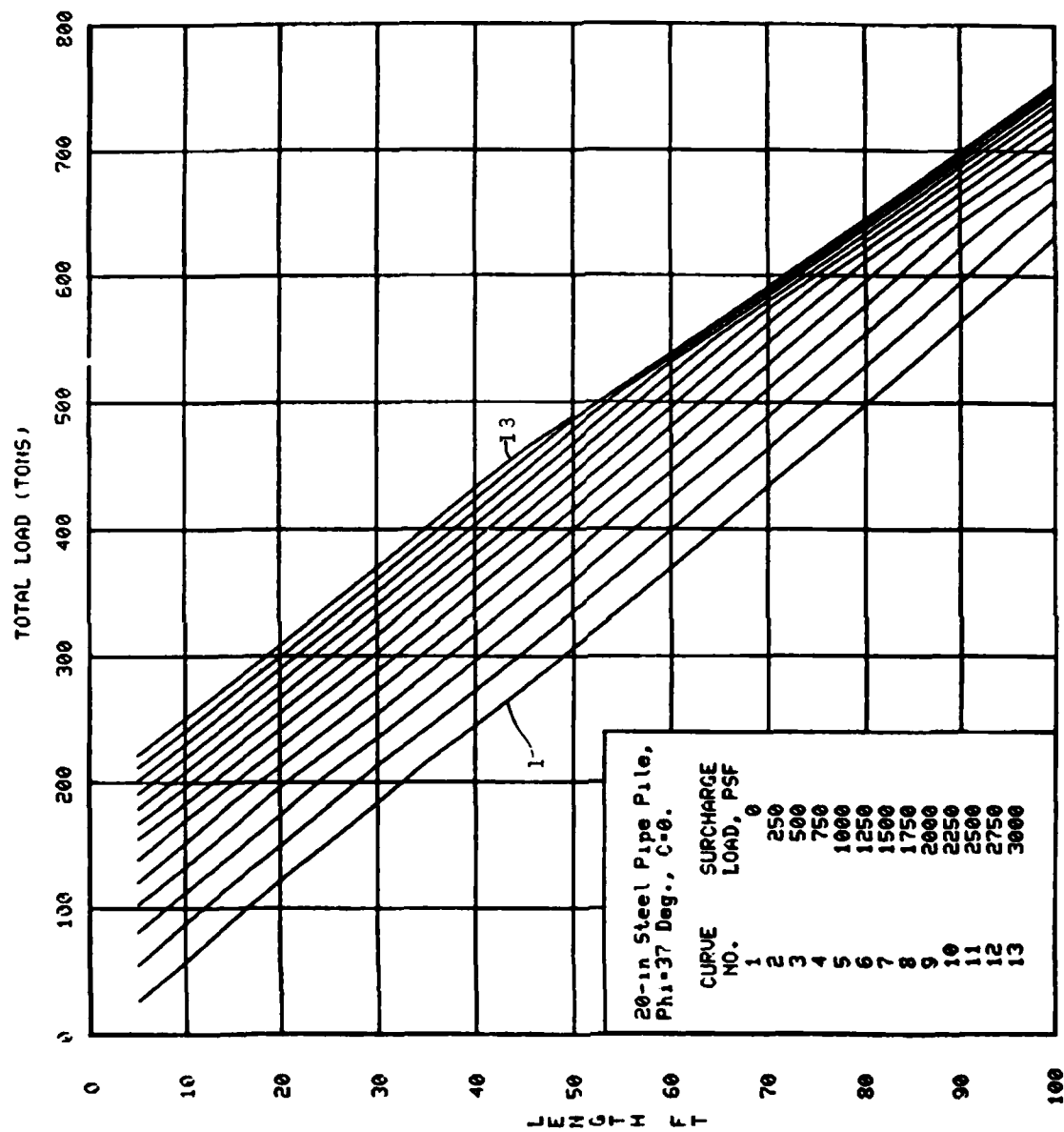


Figure 108. Total Pile Capacity For A 20-in Steel Pipe Pile, Submerged Condition, 1/4-in. Tip Movement, Phi=37 Deg., C=0.



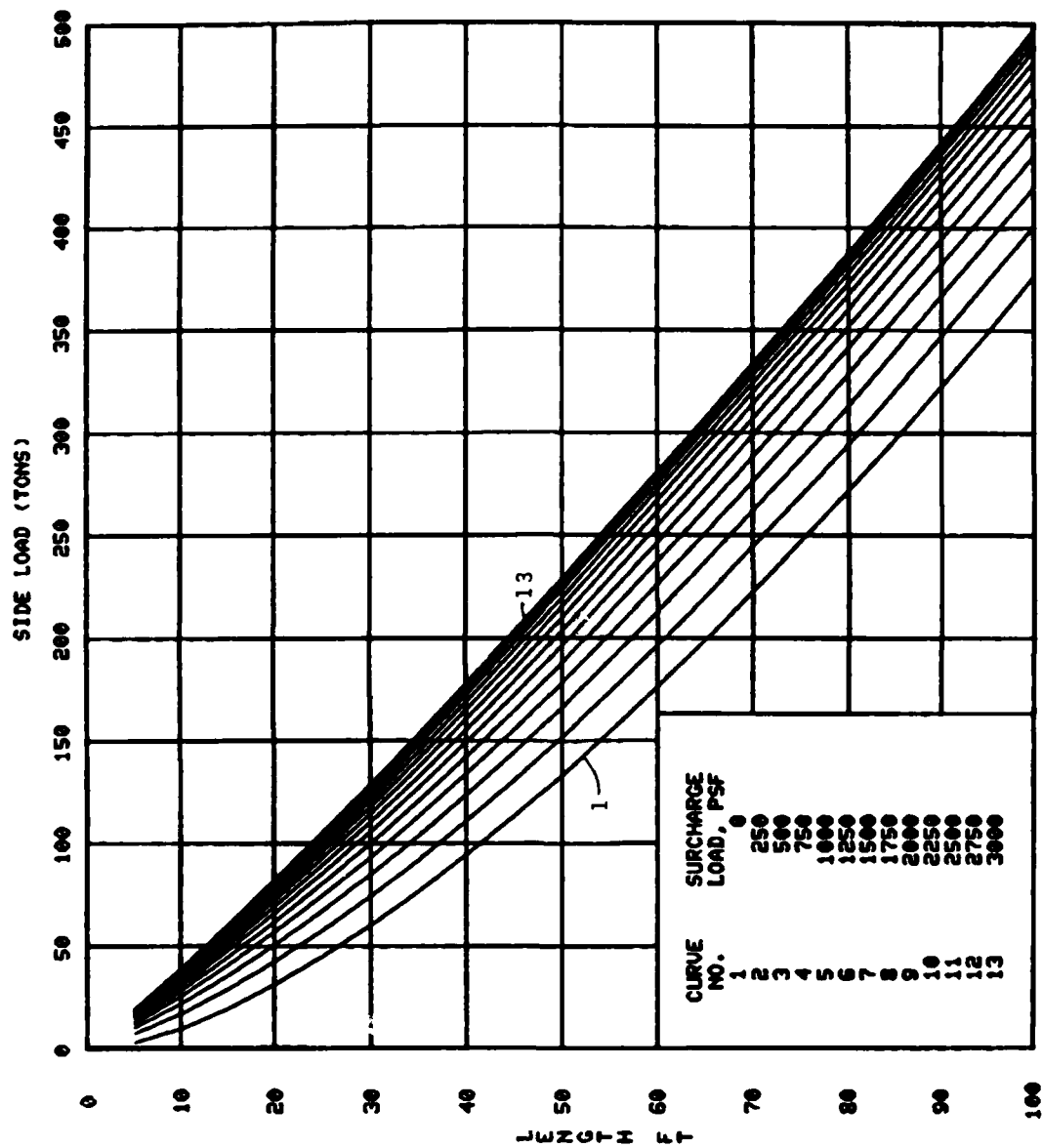


Figure 109. Side Capacity For A 20-in Steel Pipe Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi$ 1-37 Deg., C-0.



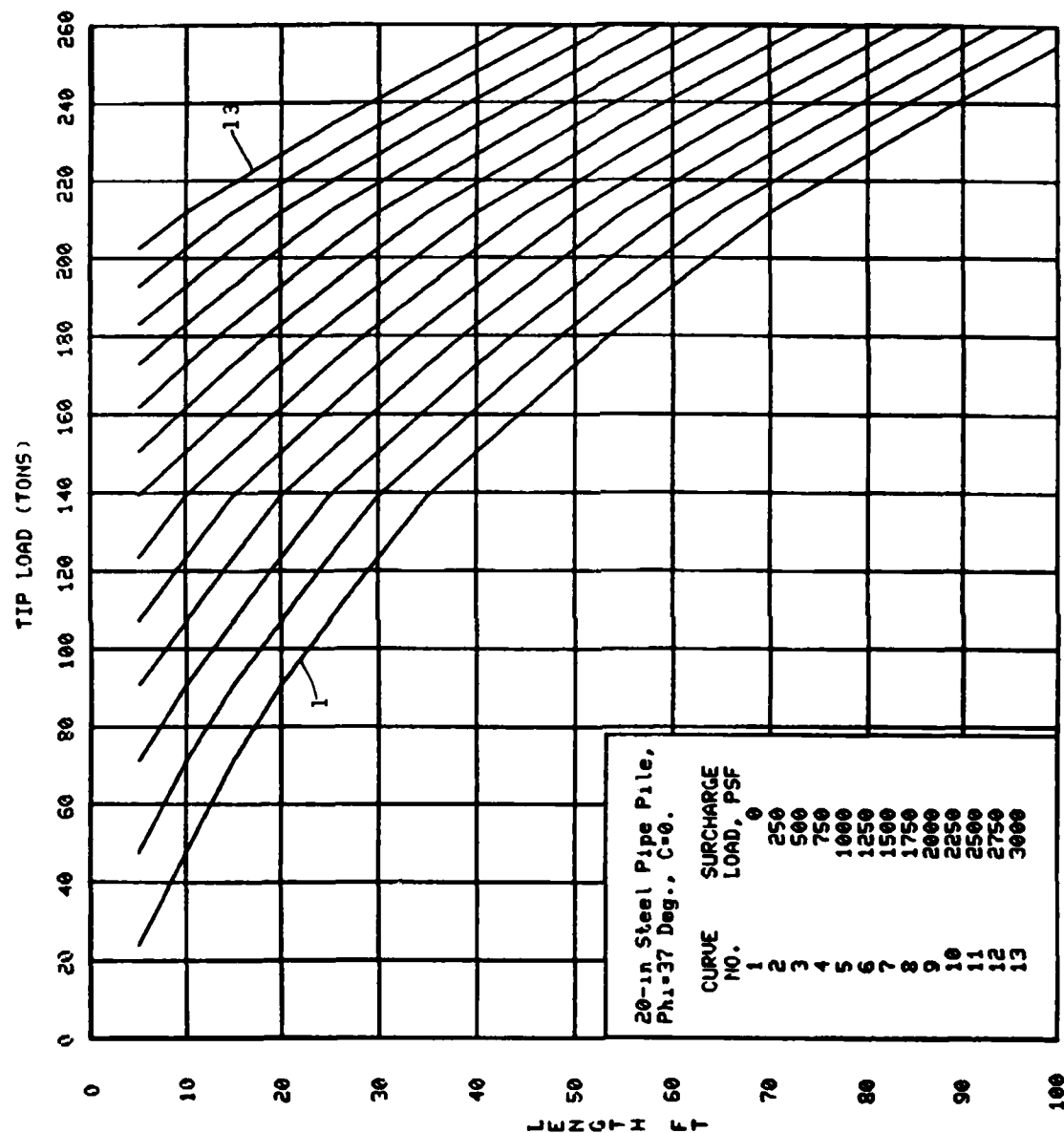


Figure 110. Tip Capacity For A 20-in Steel Pipe Pile,  
 Submerged Condition, 1/4-in. Tip Movement,  $\Phi=37$  Deg.,  $C=0$ .



## CHAPTER 4. LOAD CAPACITY CURVES FOR SQUARE CONCRETE PILES

Total pile, side, and pit capacity curves for square concrete piles are presented as follows:

<u>Curves for</u>	<u>Shown in Figure</u>
10 Inches	111-122
12 Inches	123-134
14 Inches	135-146
16 Inches	147-158
18 Inches	159-170
20 Inches	171-182



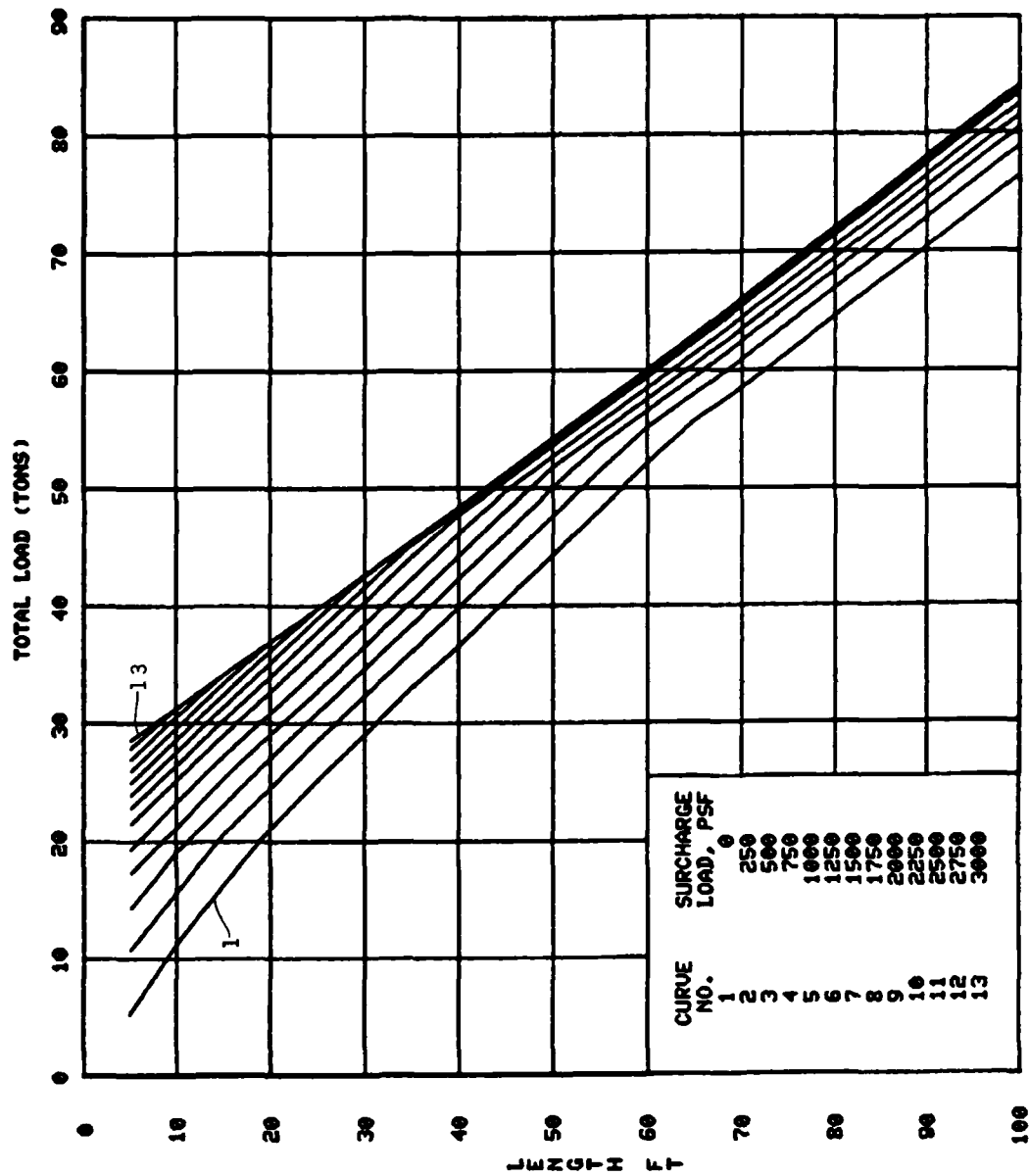


Figure 111. Total Pile Capacity For A 10-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\phi=30$  Deg., C-8.



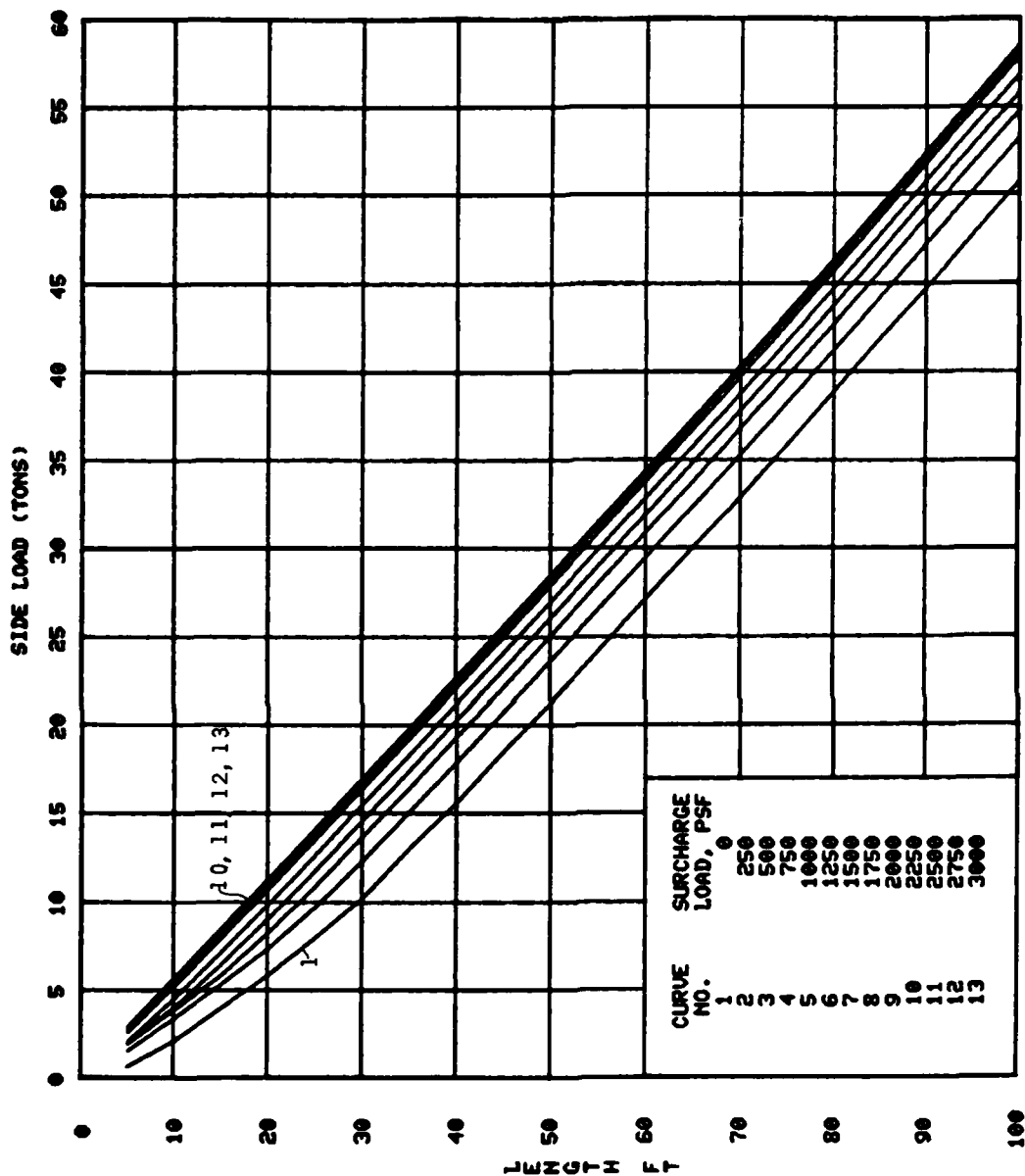


Figure 112. Side Capacity For A 10-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\phi = 30^\circ$  Deg., C-6.



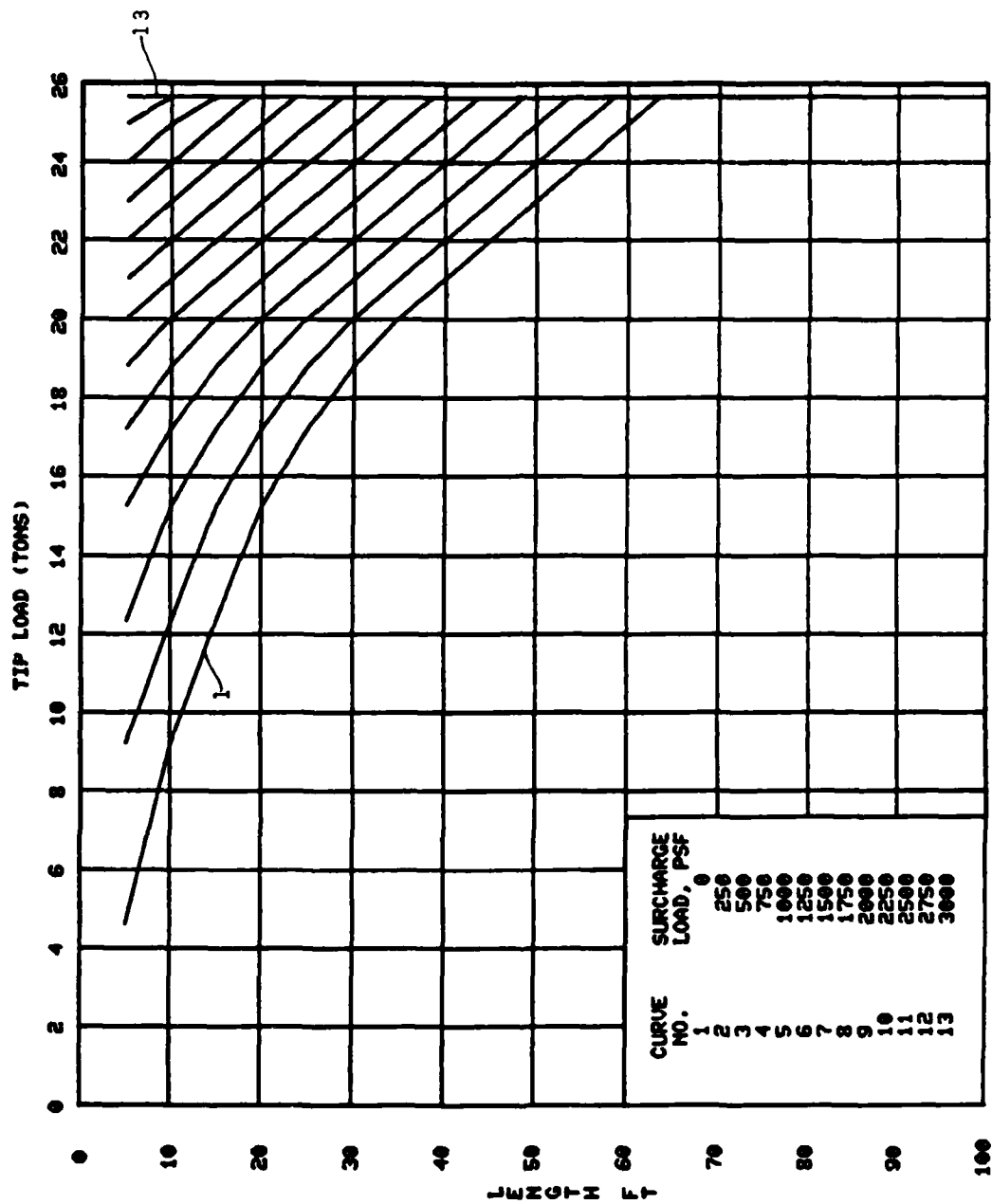


Figure 113. Tip Capacity For A 10-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi$ 1-30 Deg., C-0.



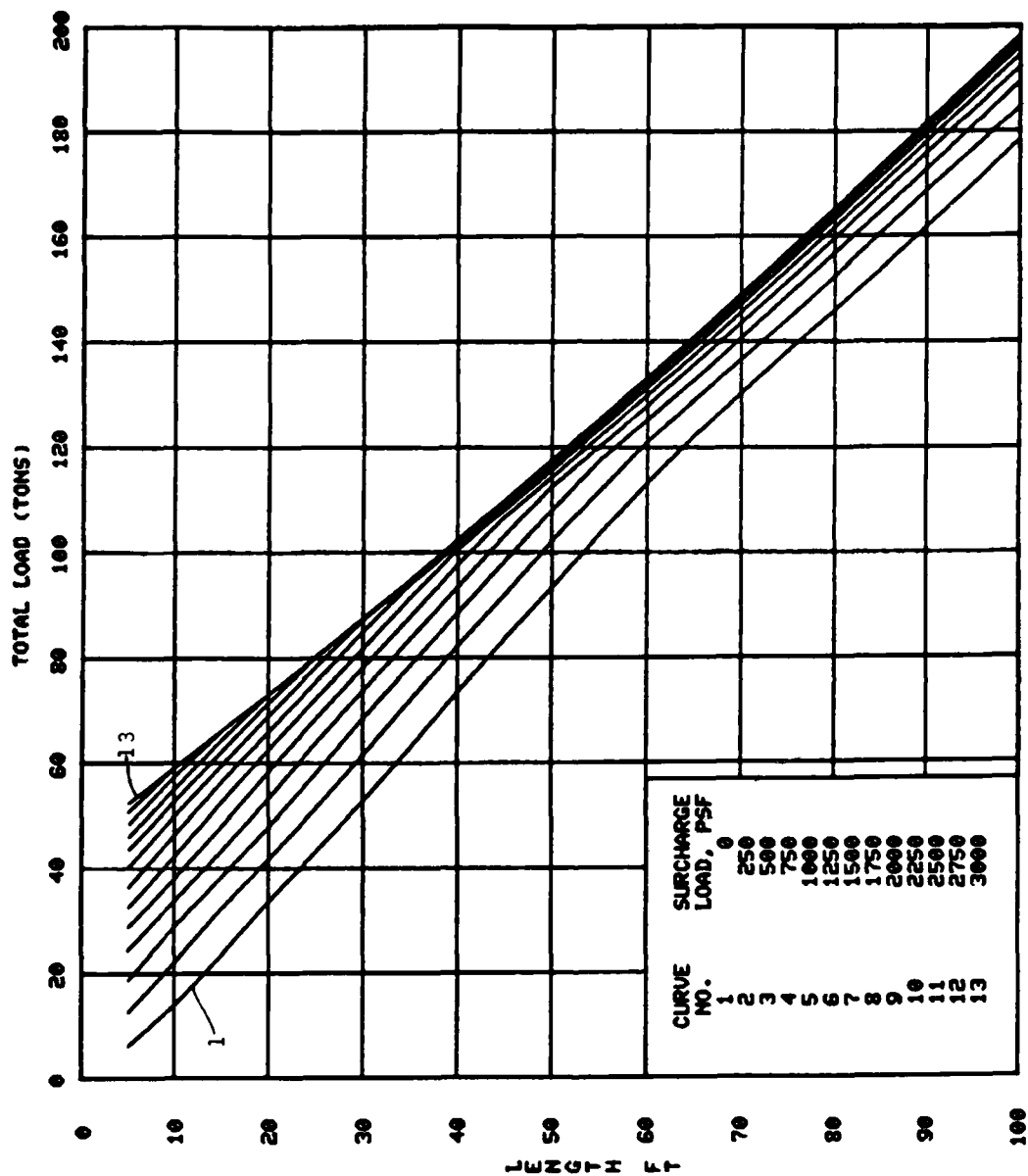


Figure 114. Total Pile Capacity For A 10-in Square Concrete Pile. Submerged Condition, 1/4-in. Tip Movement,  $\Phi=33$  Deg., C-0.



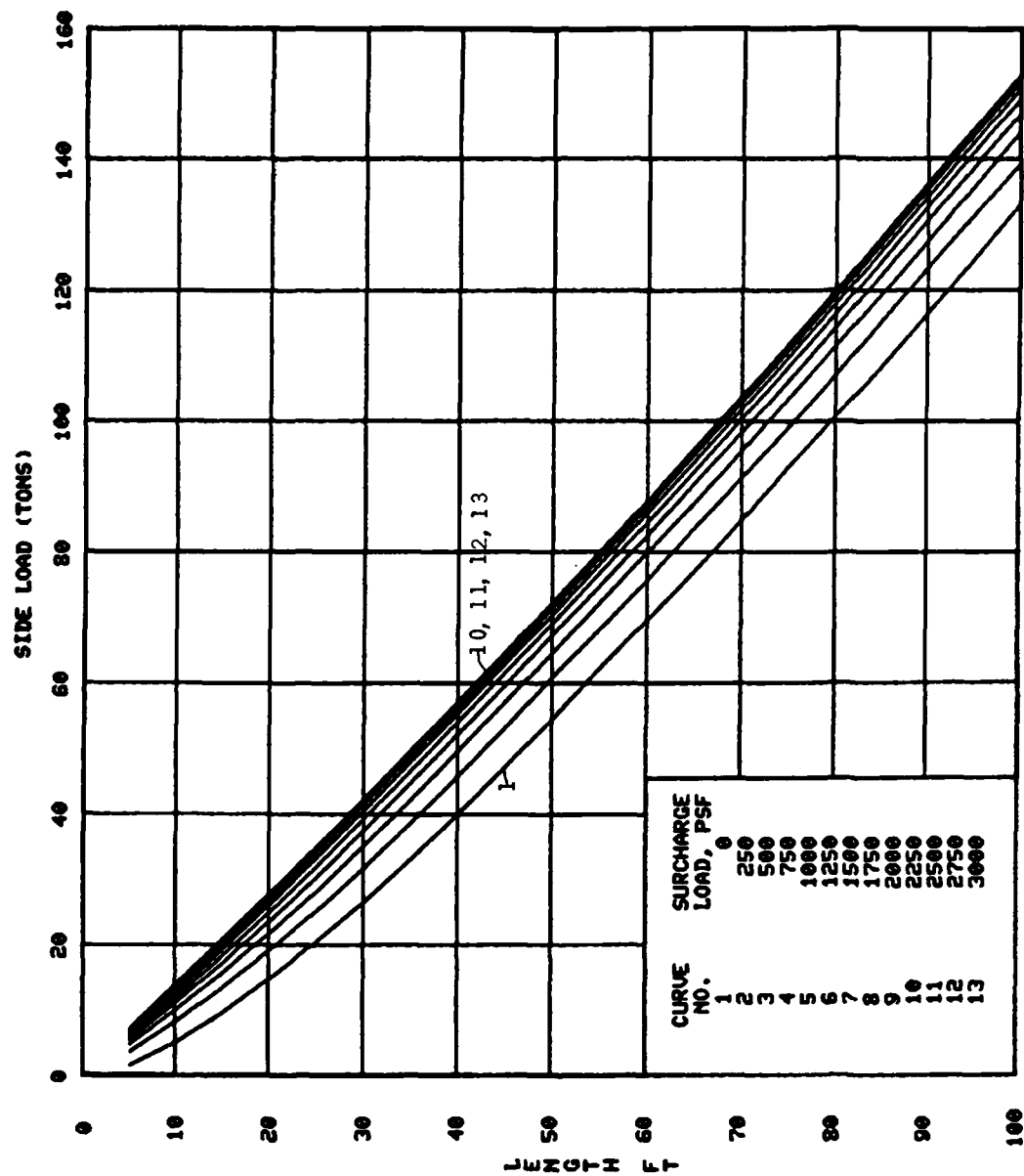


Figure 115. Side Capacity For A 10-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi=33$  Deg., C-6.



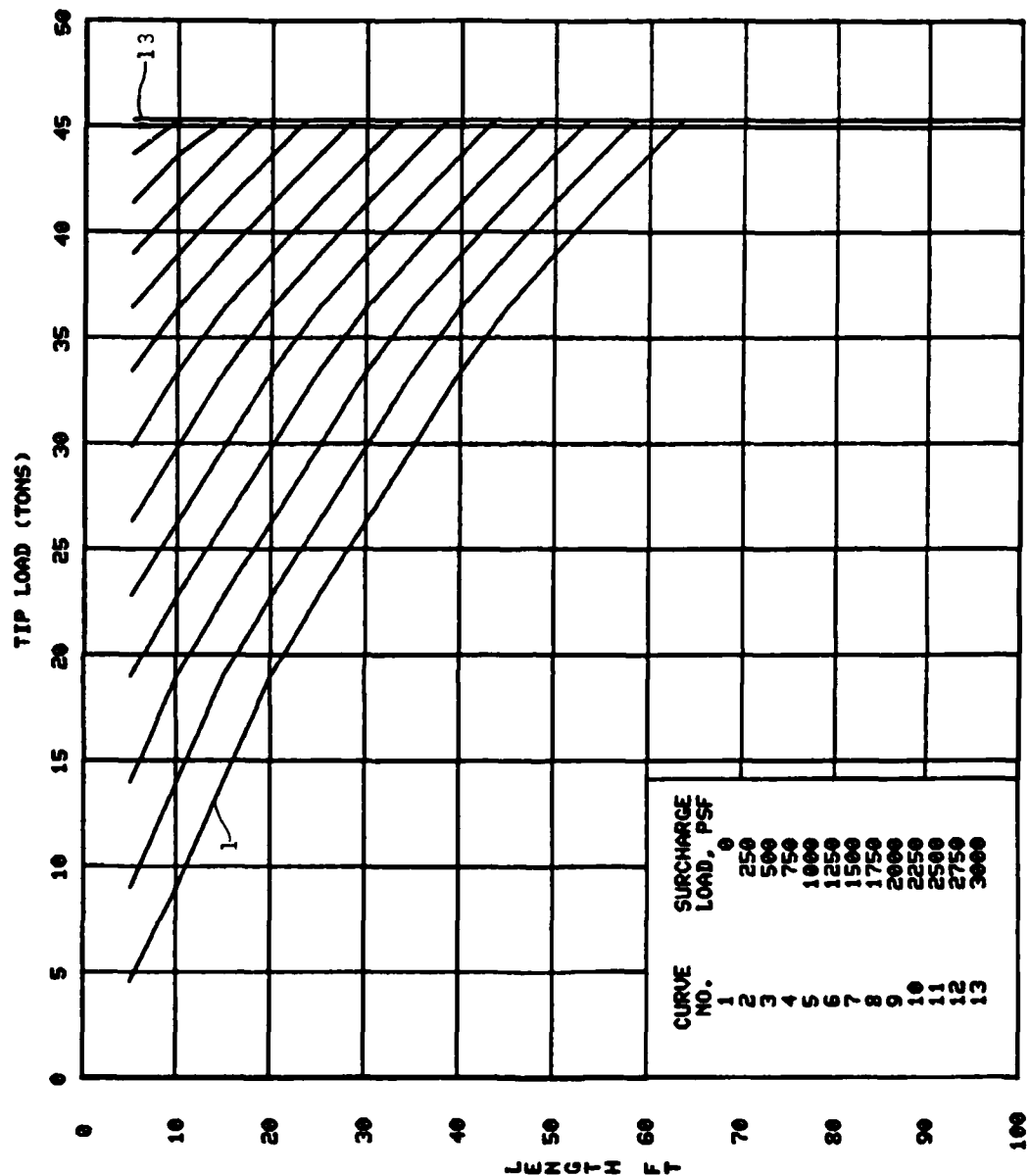


Figure 116. Tip Capacity For A 10-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\phi=33$  Deg., C-0.



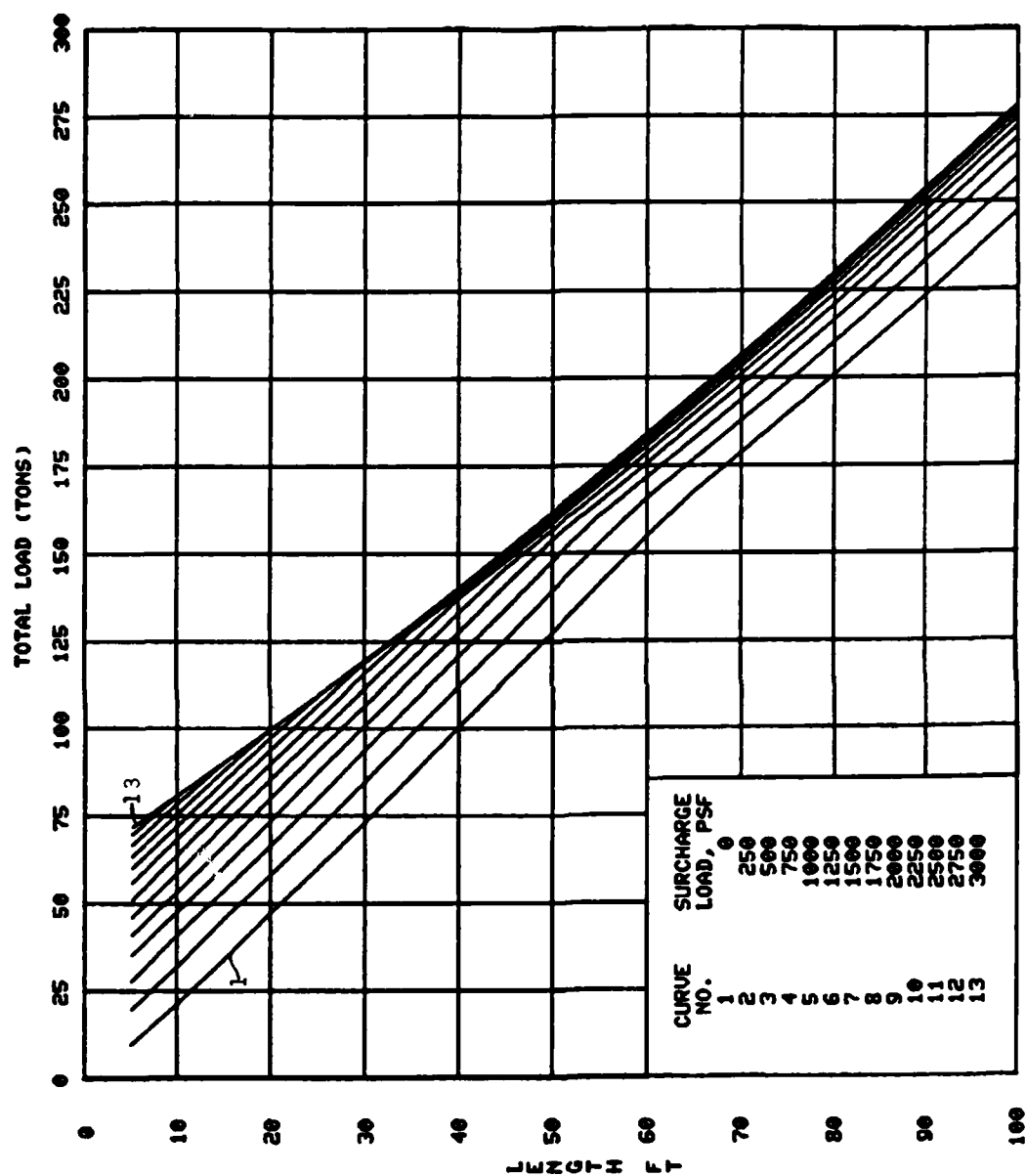


Figure 117. Total Pile Capacity For A 10-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\phi=35^\circ$  Deg., C-8.



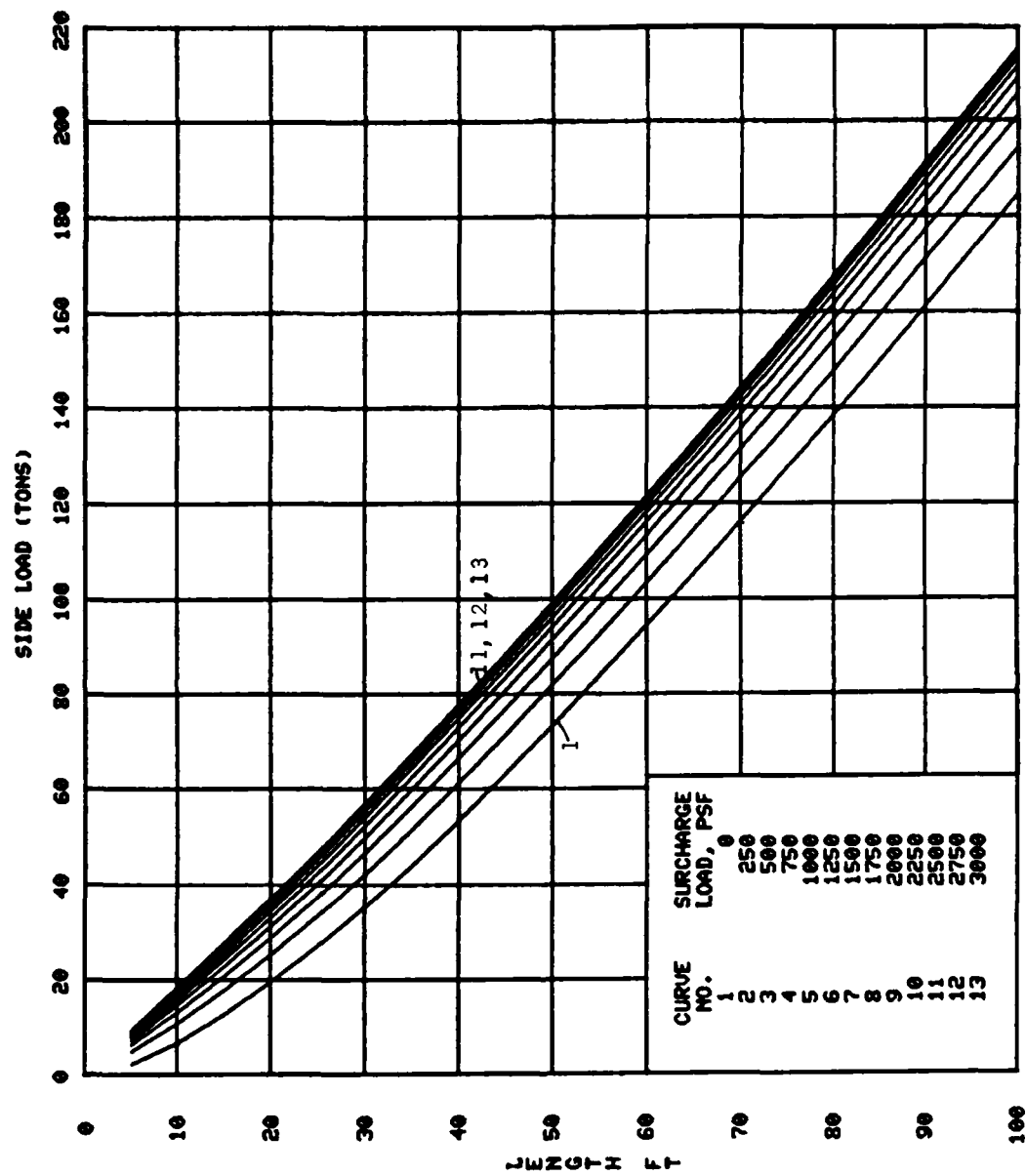


Figure 118. Side Capacity For A 10-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi$ 1-35 Deg., C-6.



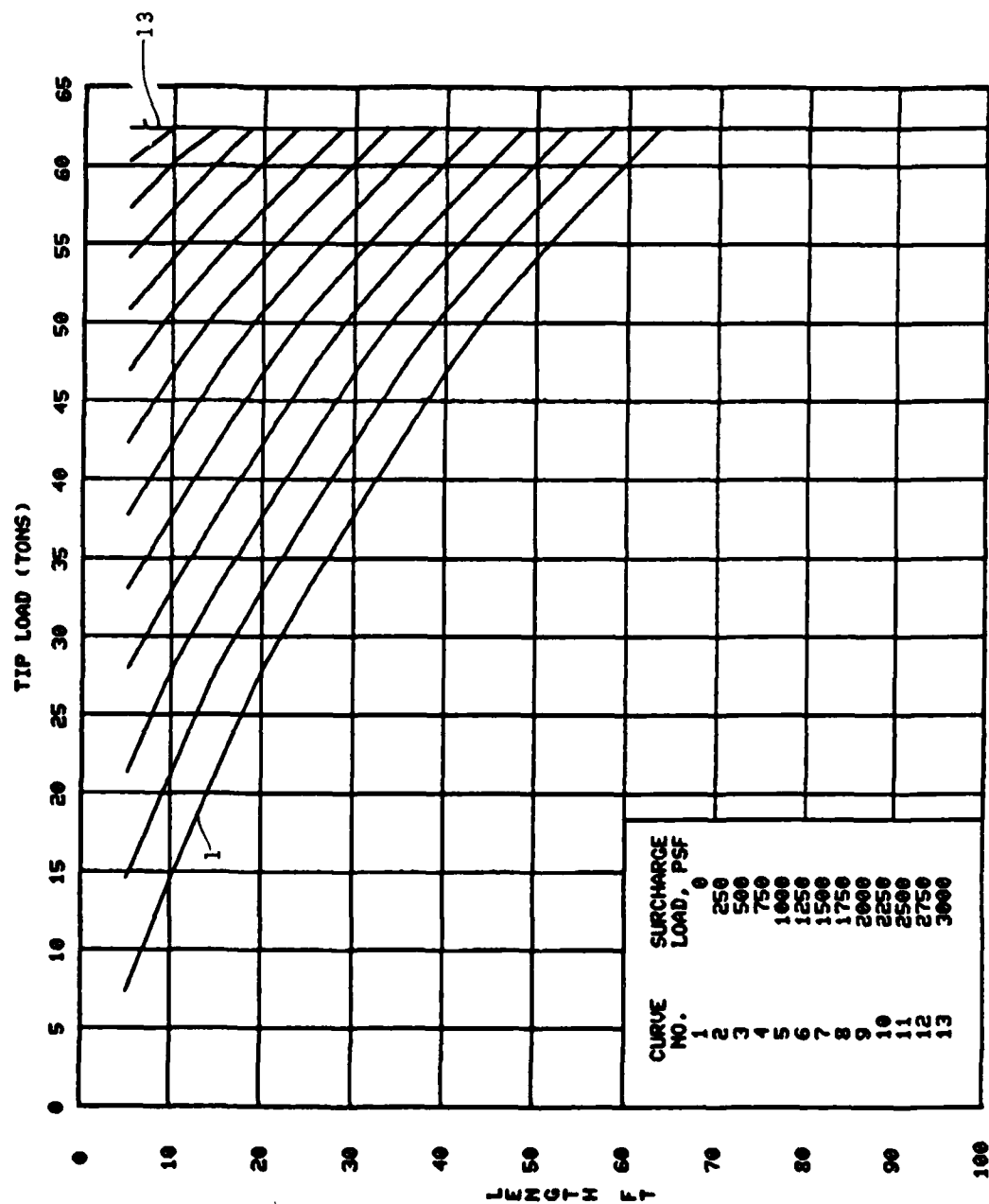


Figure 119. Tip Capacity For A 10-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi$ 1-35 Deg., C-6.



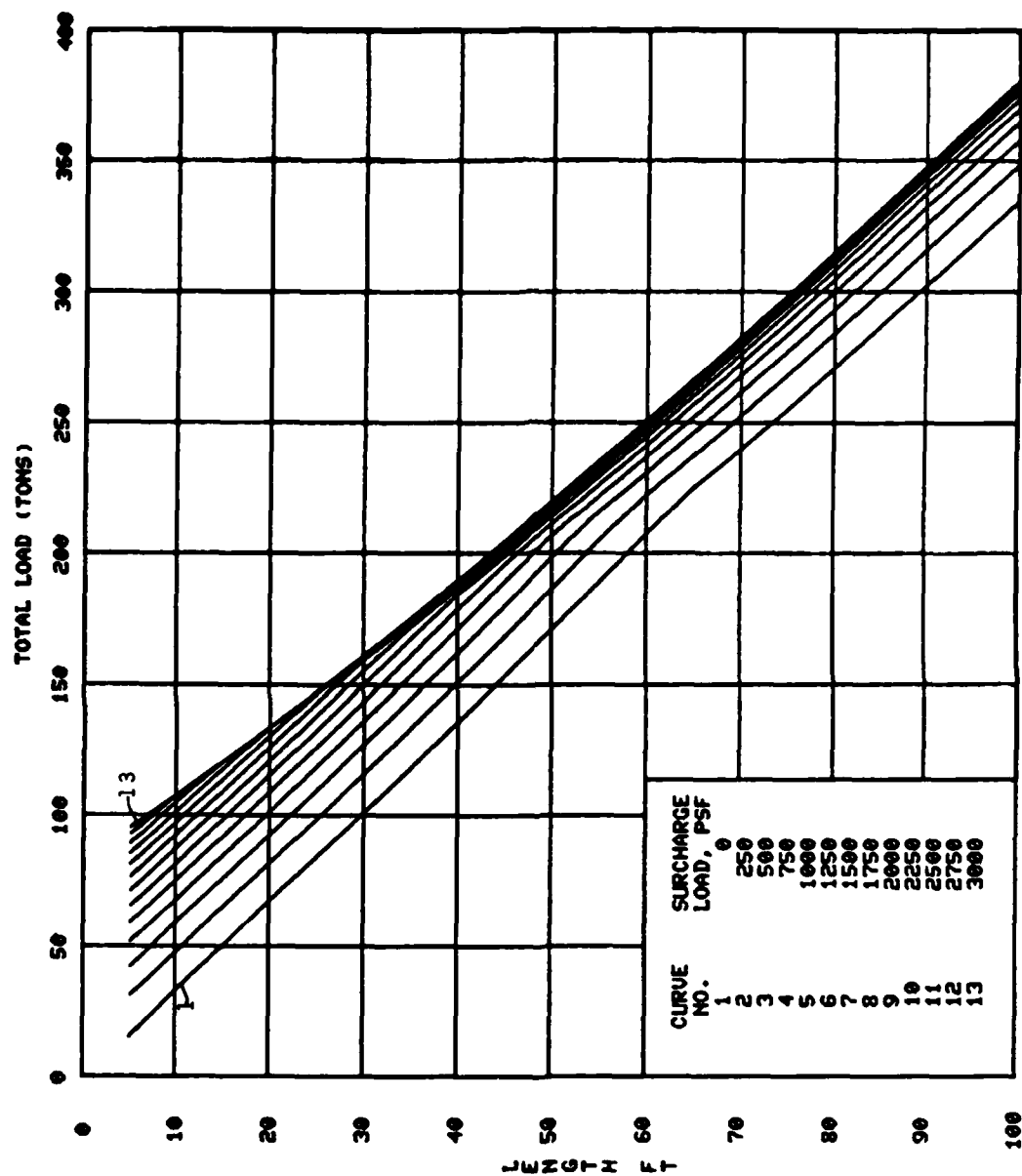


Figure 120. Total Pile Capacity For A 10-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\phi=37$  Deg., C-9.



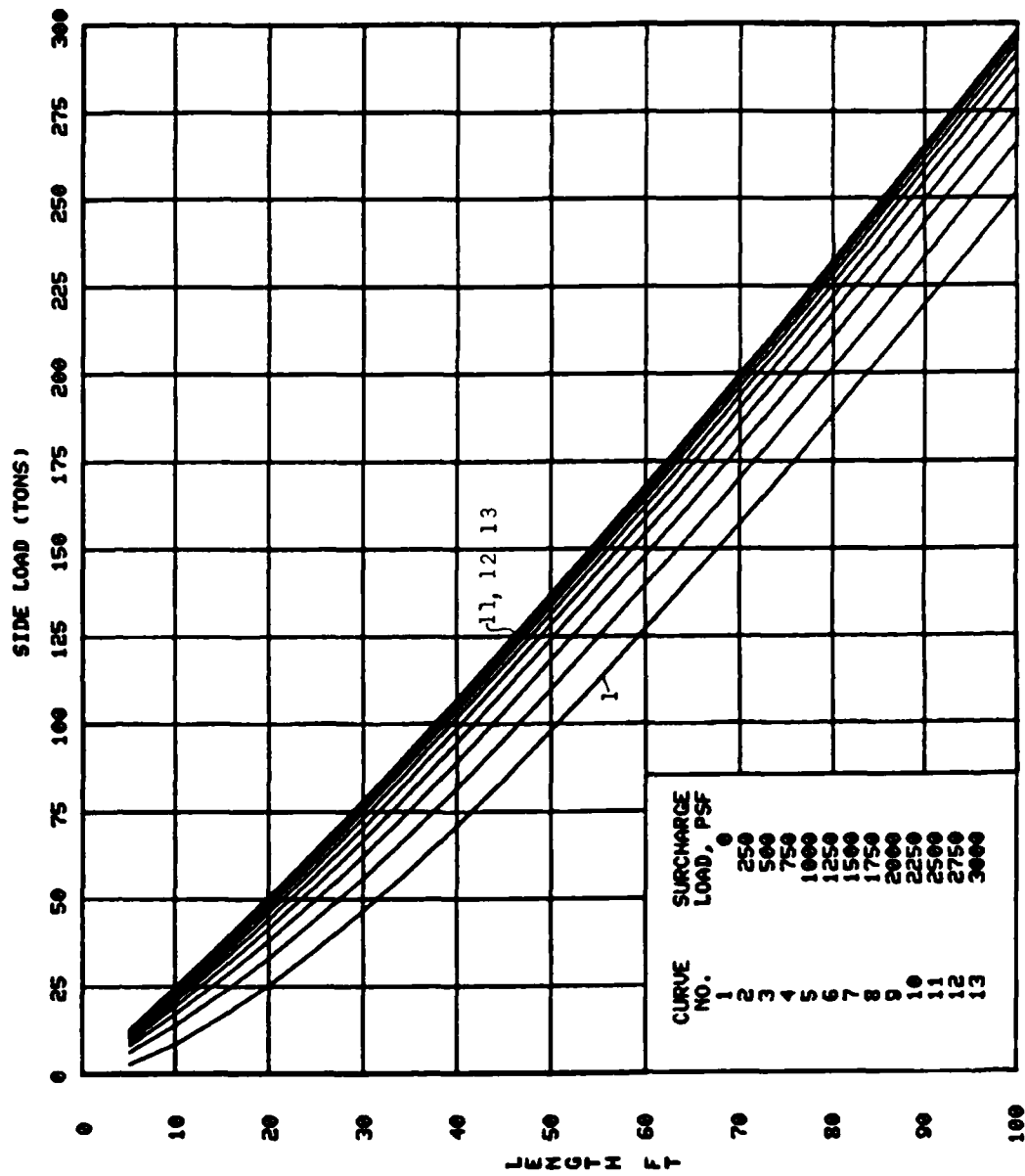


Figure 121. Side Capacity For A 10-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi=37$  Deg.,  $C=0$ .



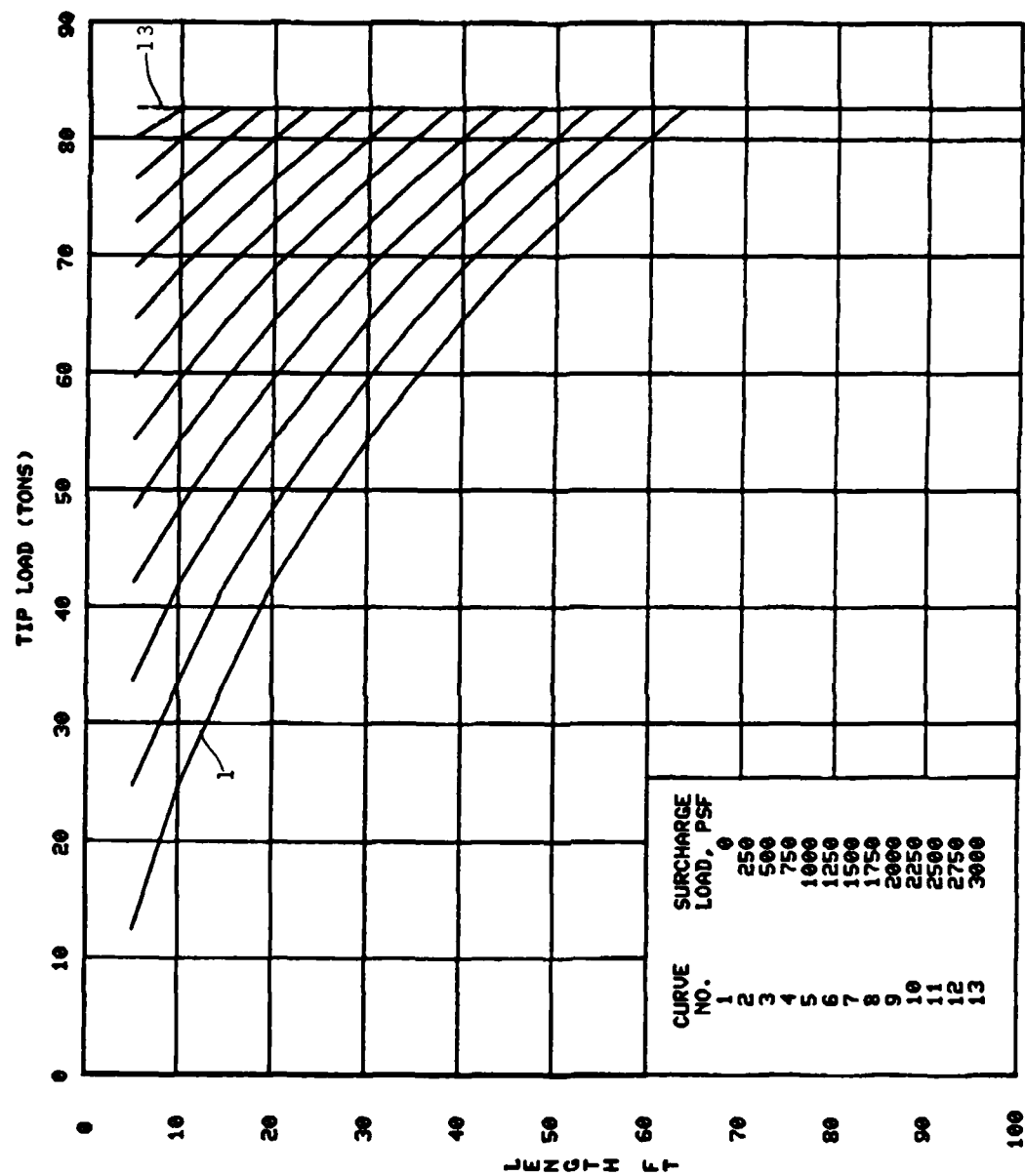


Figure 122. Tip Capacity For A 10-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi=37$  Deg., C-0.



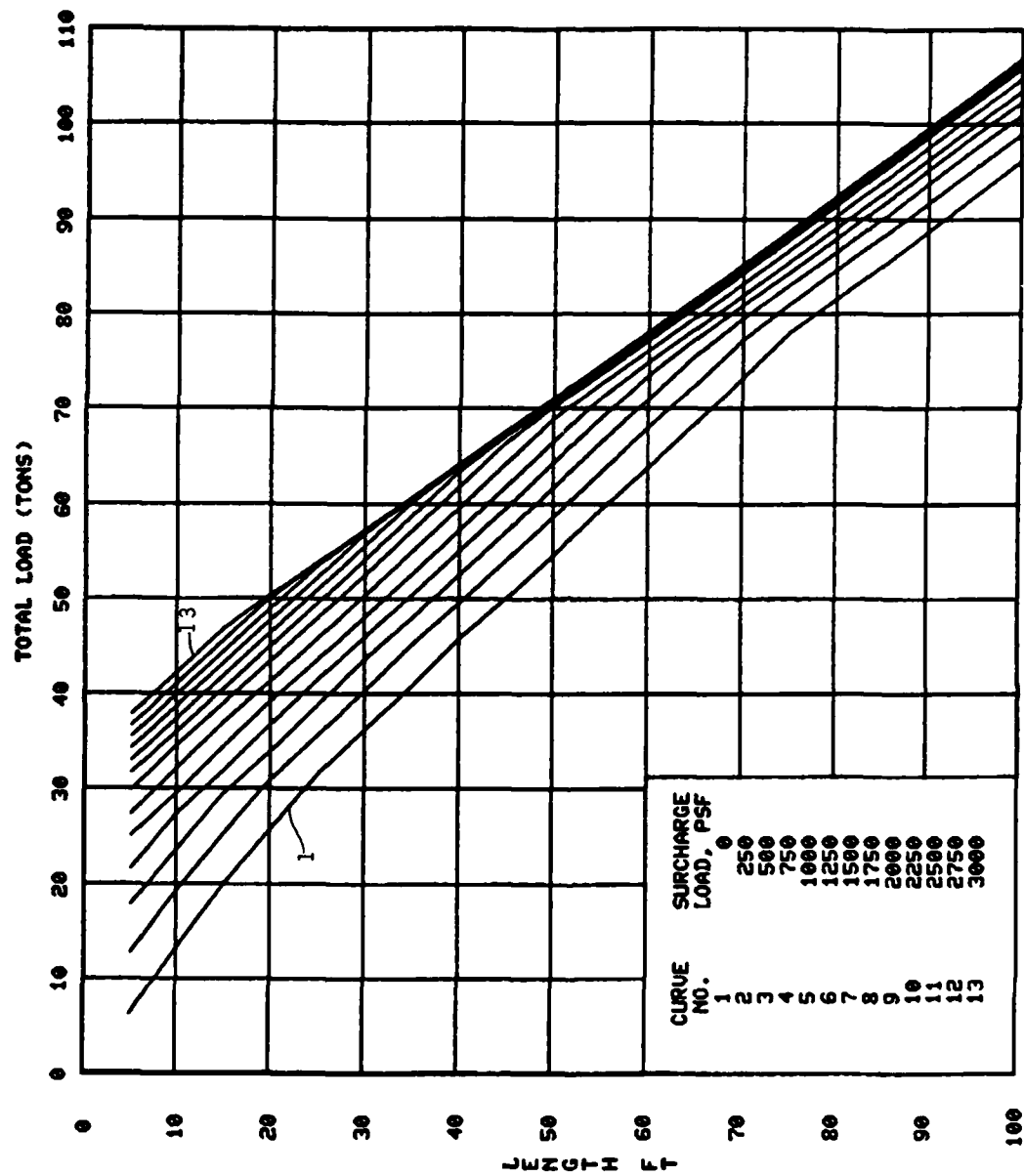


Figure 123. Total Pile Capacity For A 12-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\phi = 30^\circ$ , C-0.



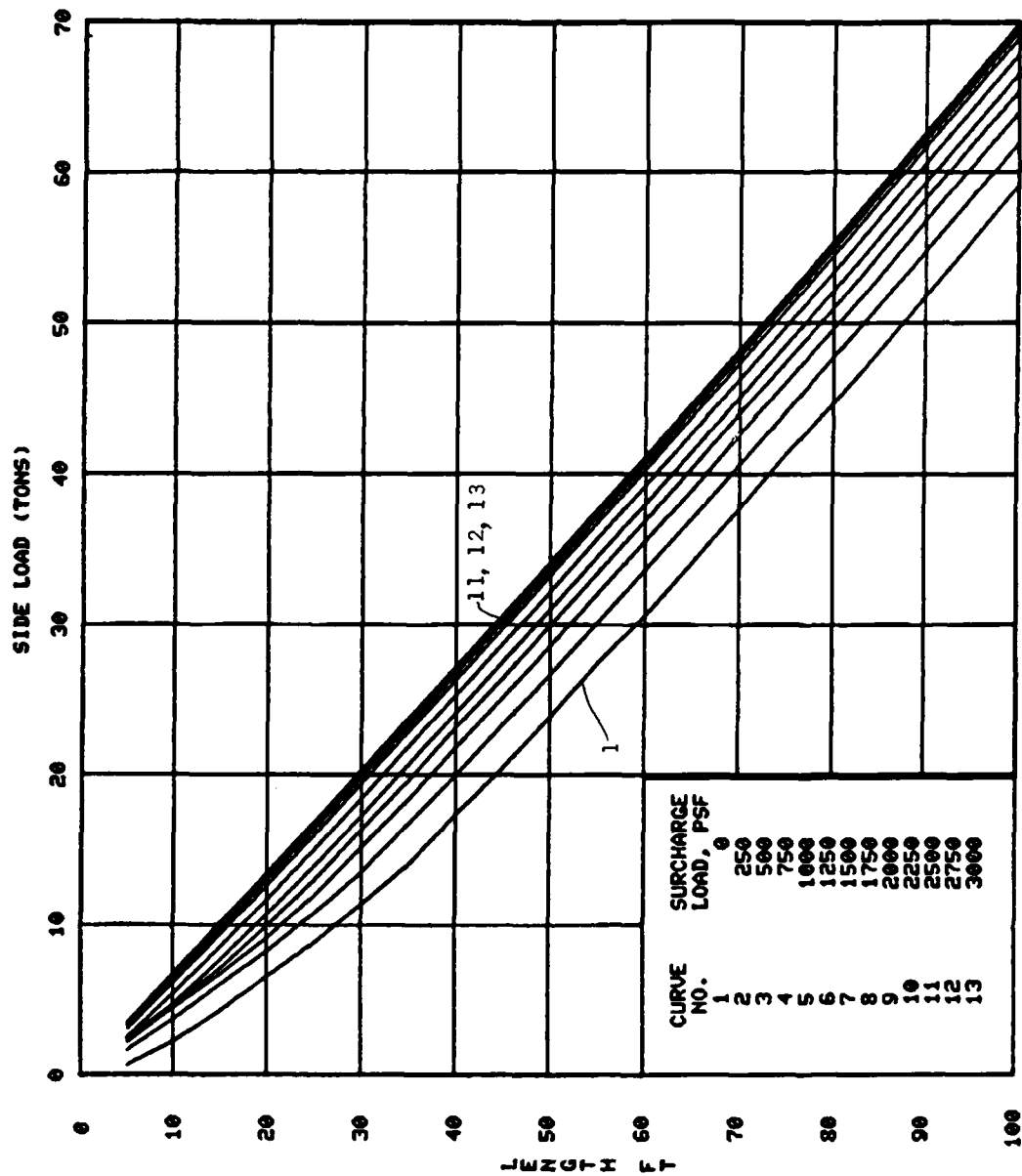


Figure 124. Side Capacity For A 12-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\phi = 30^\circ$ .



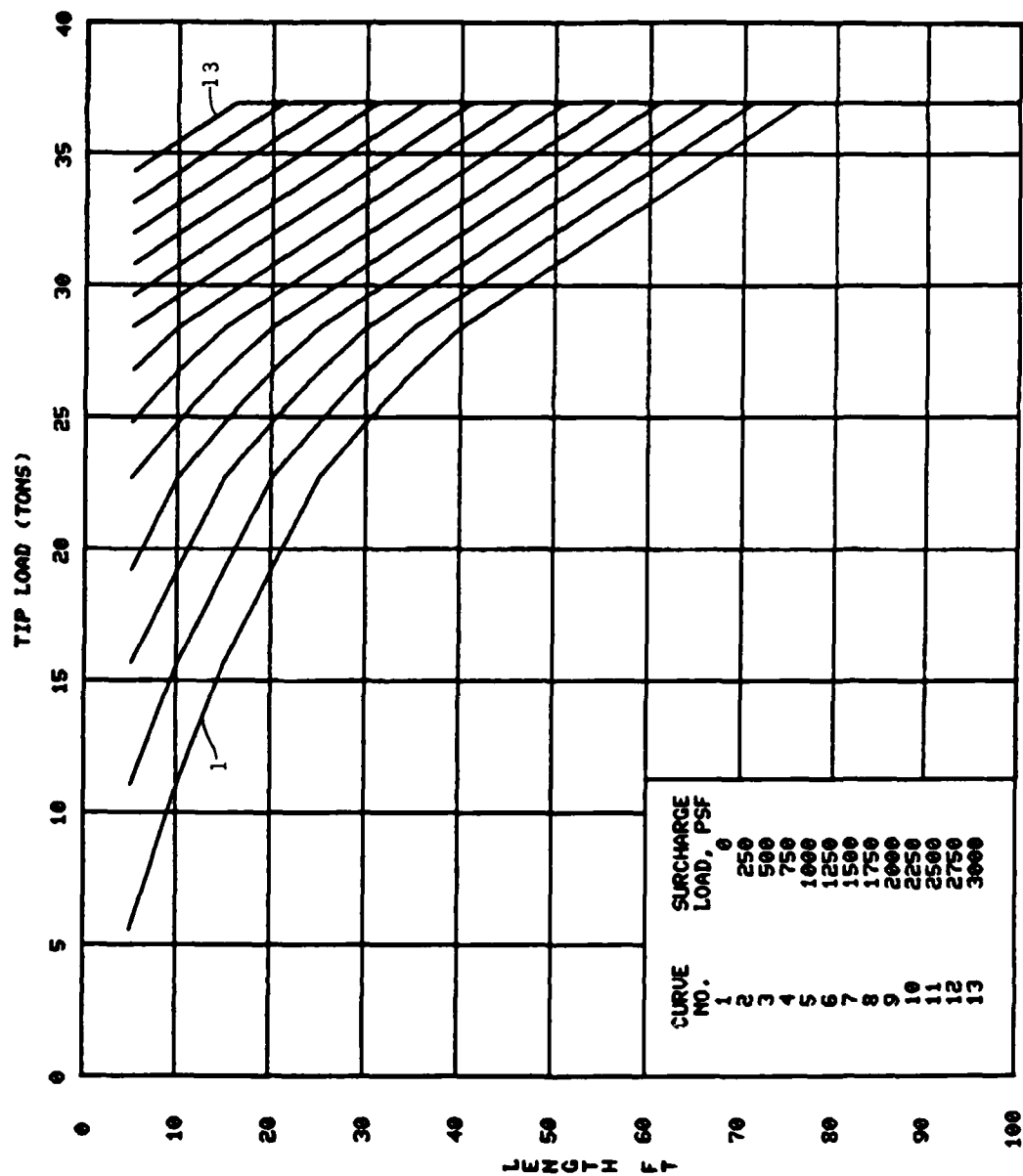


Figure 125. Tip Capacity For A 12-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\phi=30$  Deg.,  $C=0$ .



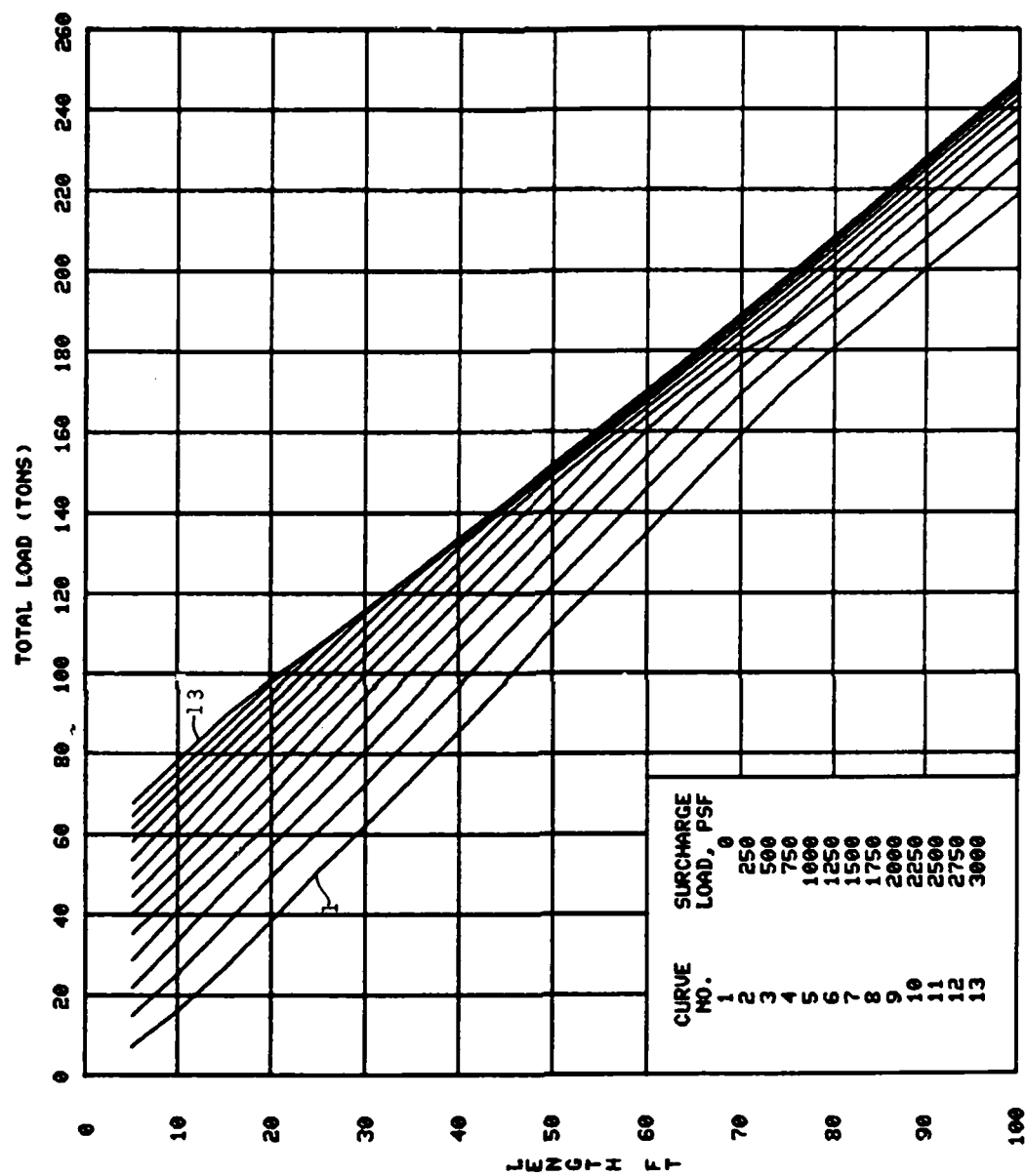


Figure 126. Total Pile Capacity For A 12-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi$ 1-33 Deg., C-0.



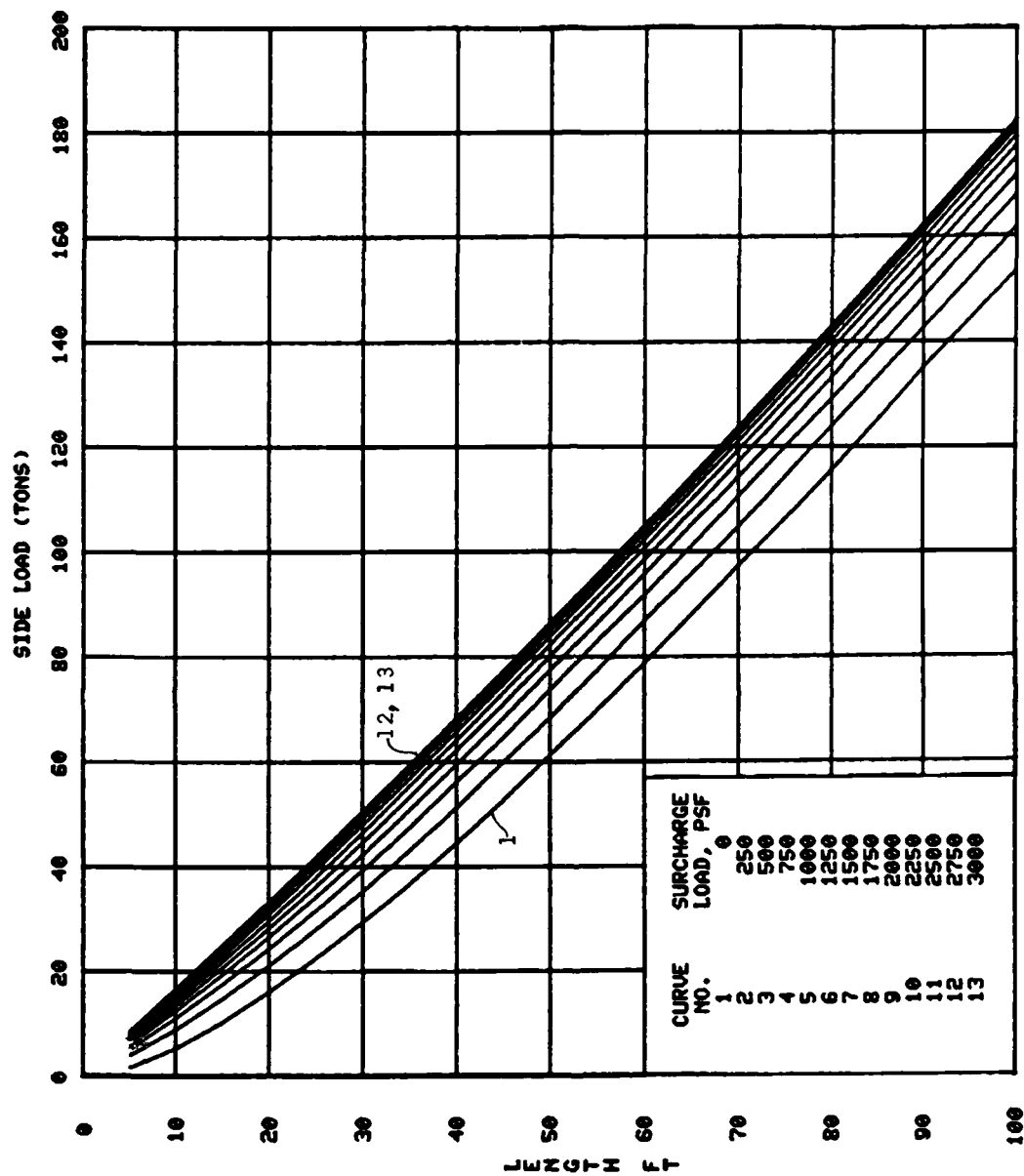


Figure 127. Side Capacity For A 12-in Square Concrete Pile. Submerged Condition, 1/4-in. Tip Movement,  $\Phi$ 1-33 Deg., C-0.



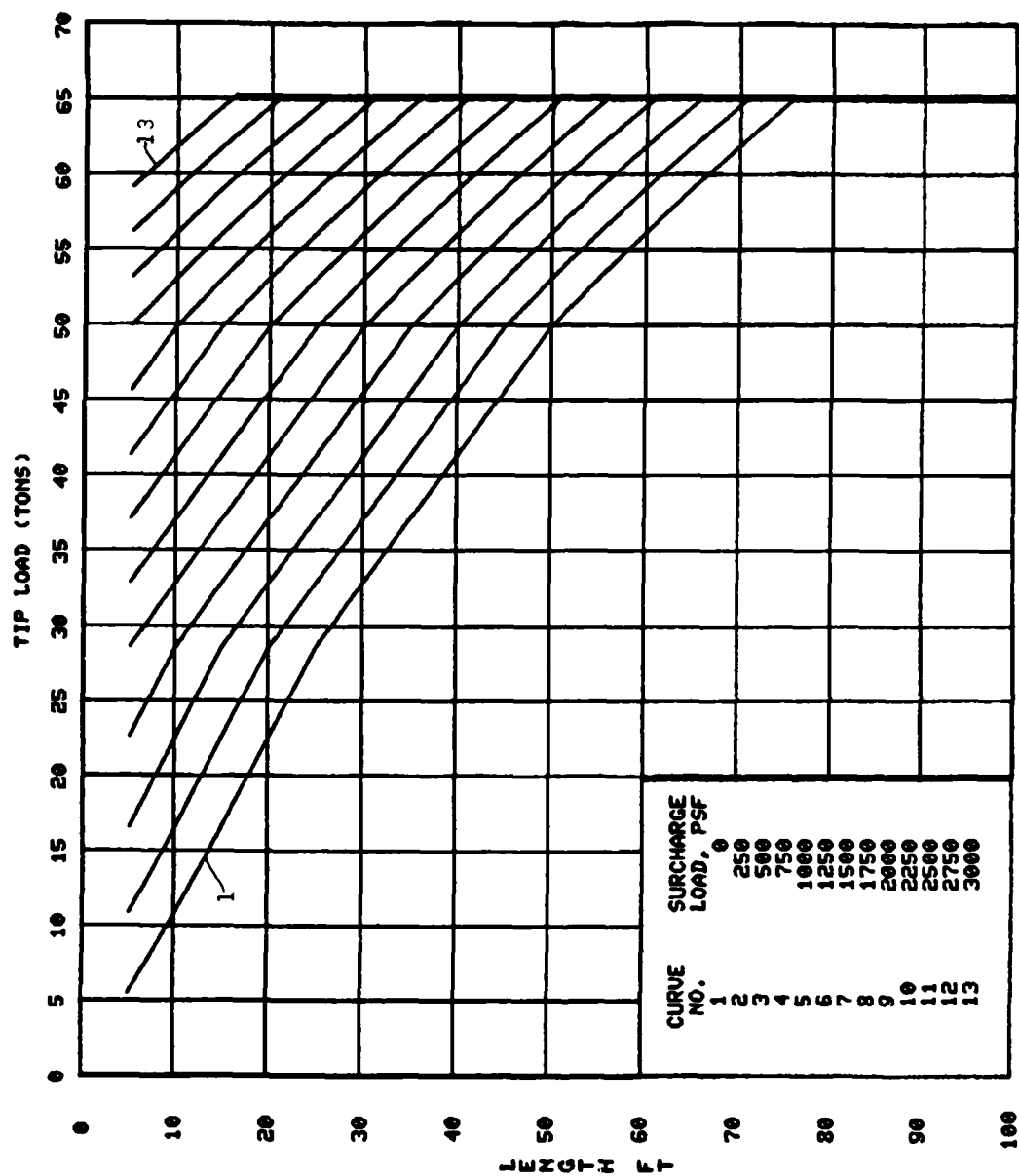


Figure 128. Tip Capacity For A 12-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi$ 1-33 Deg., C-0.



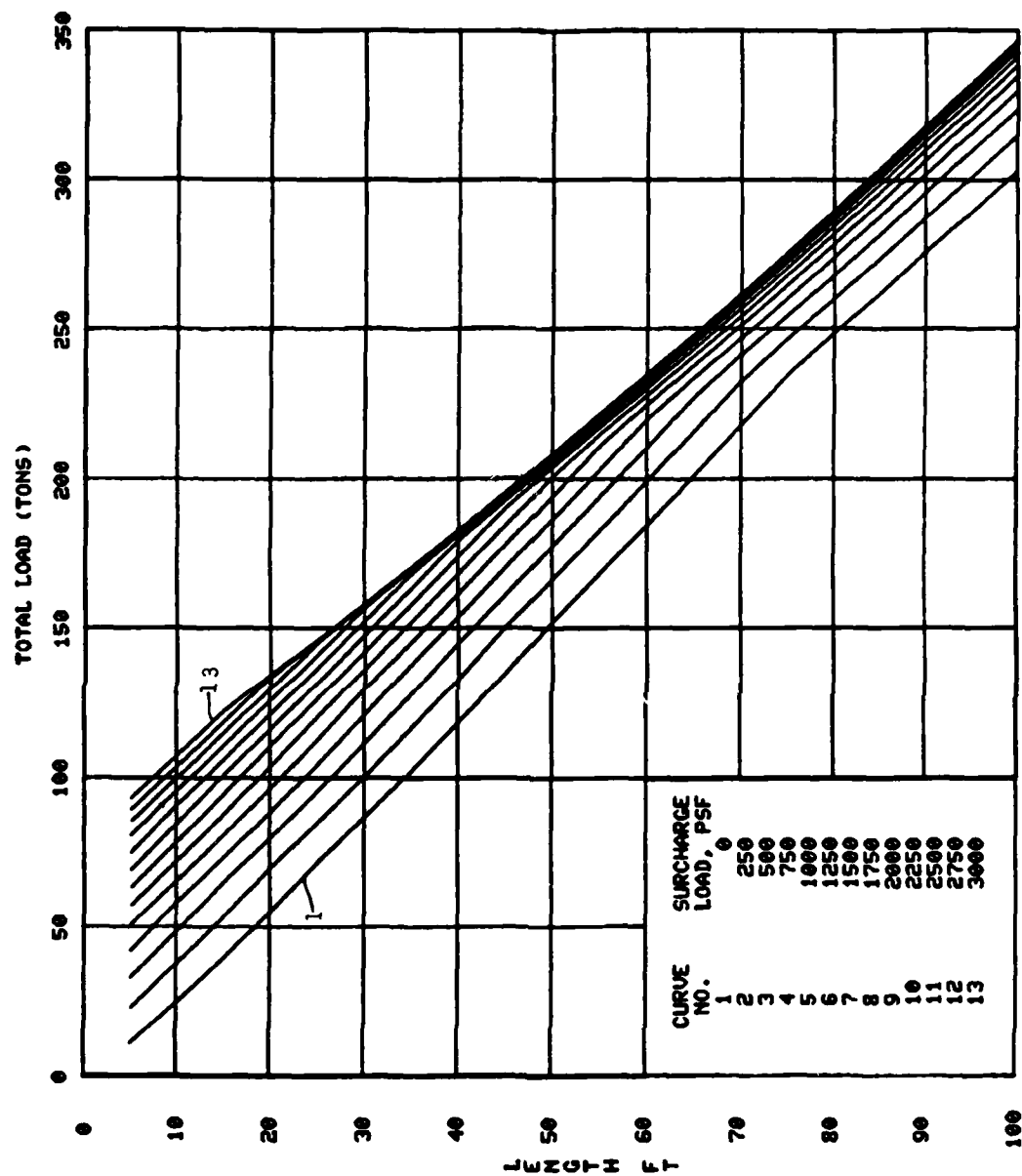


Figure 129. Total Pile Capacity For A 12-in Square Concrete Pile. Submerged Condition, 1/4-in. Tip Movement,  $\Phi$ 1-35 Deg., C-0.



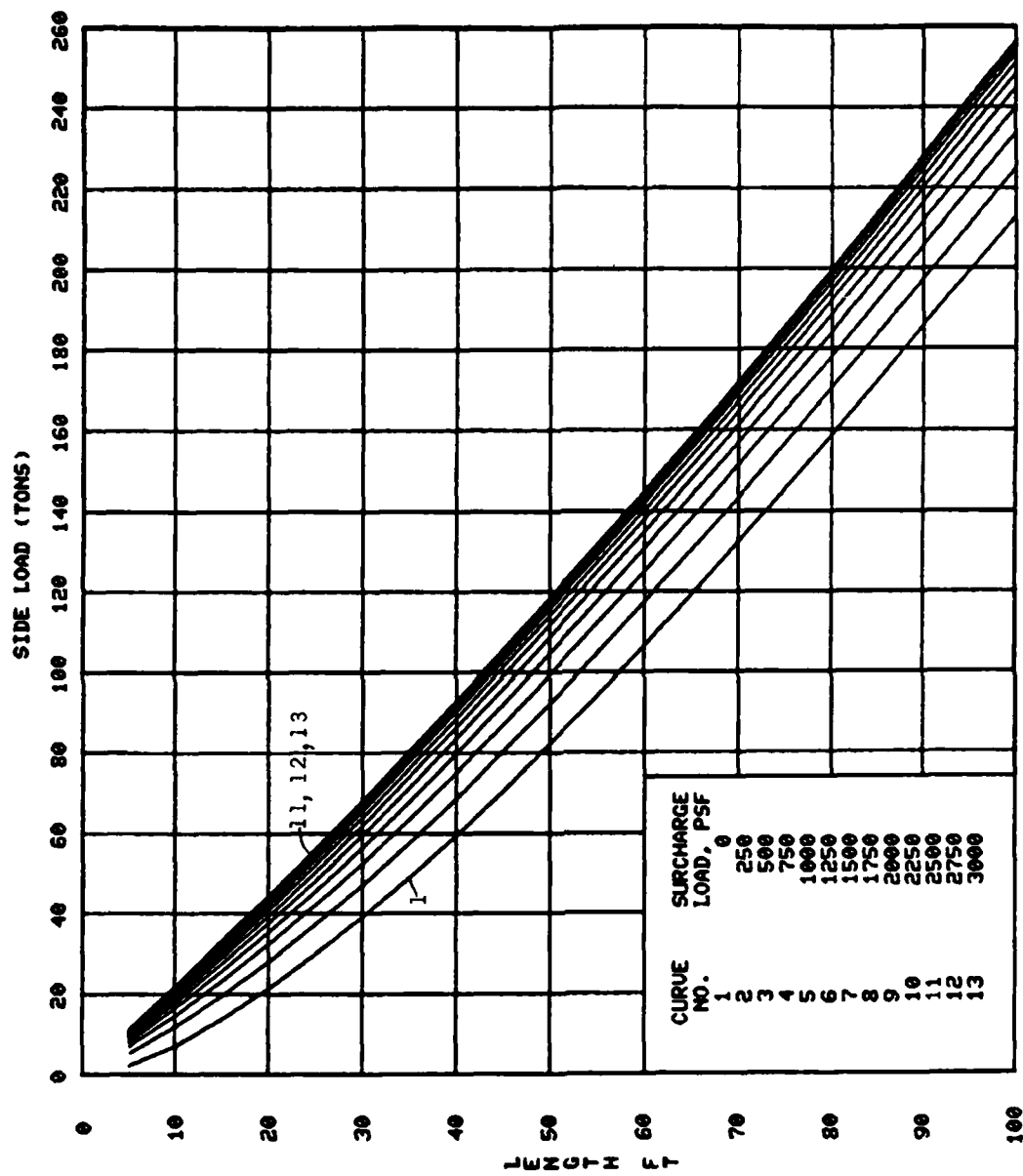


Figure 130. Side Capacity For A 12-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\phi=35$  Deg., C-0.



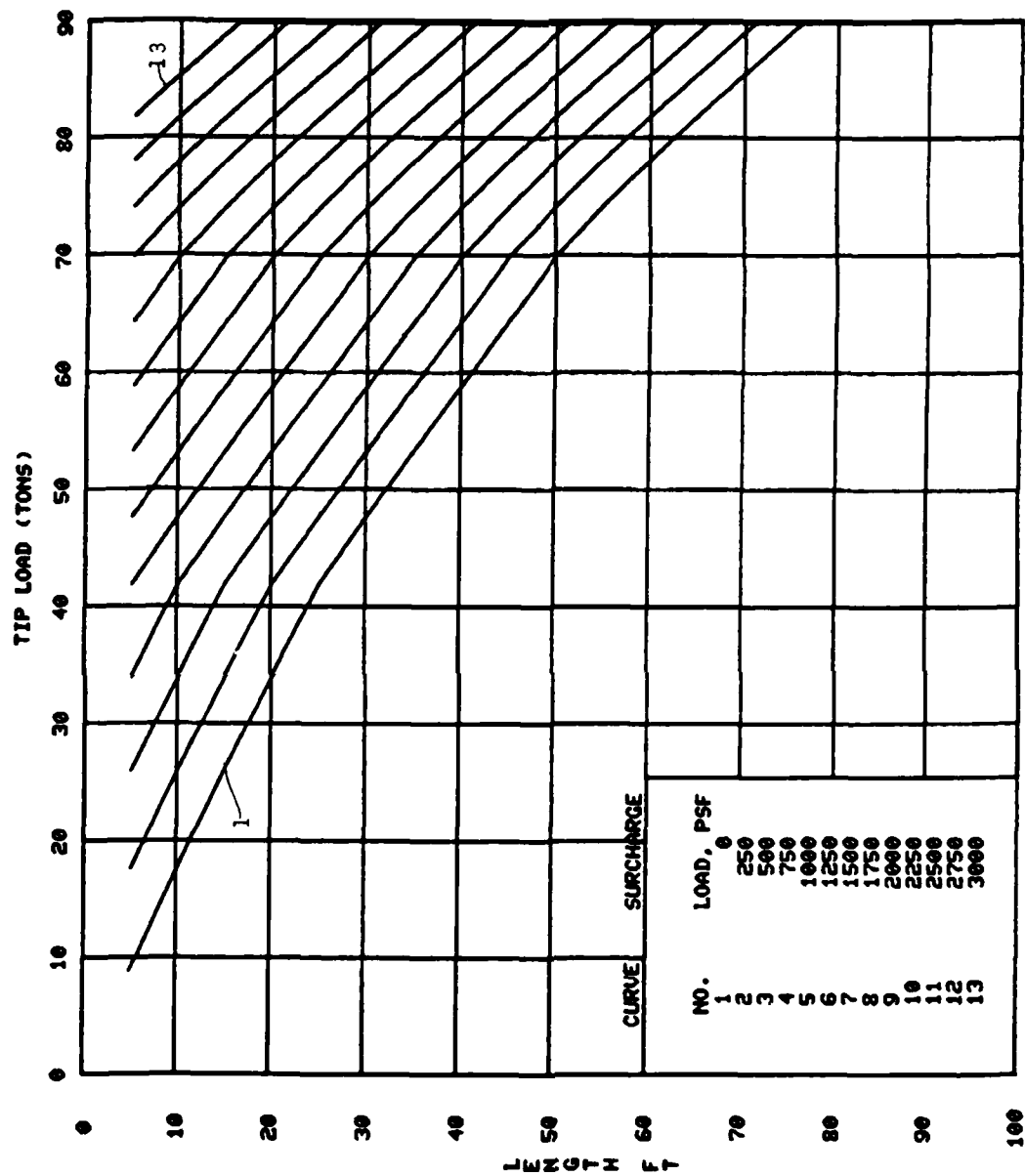


Figure 131. Tip Capacity For A 12-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi=35$  Deg., C-0.



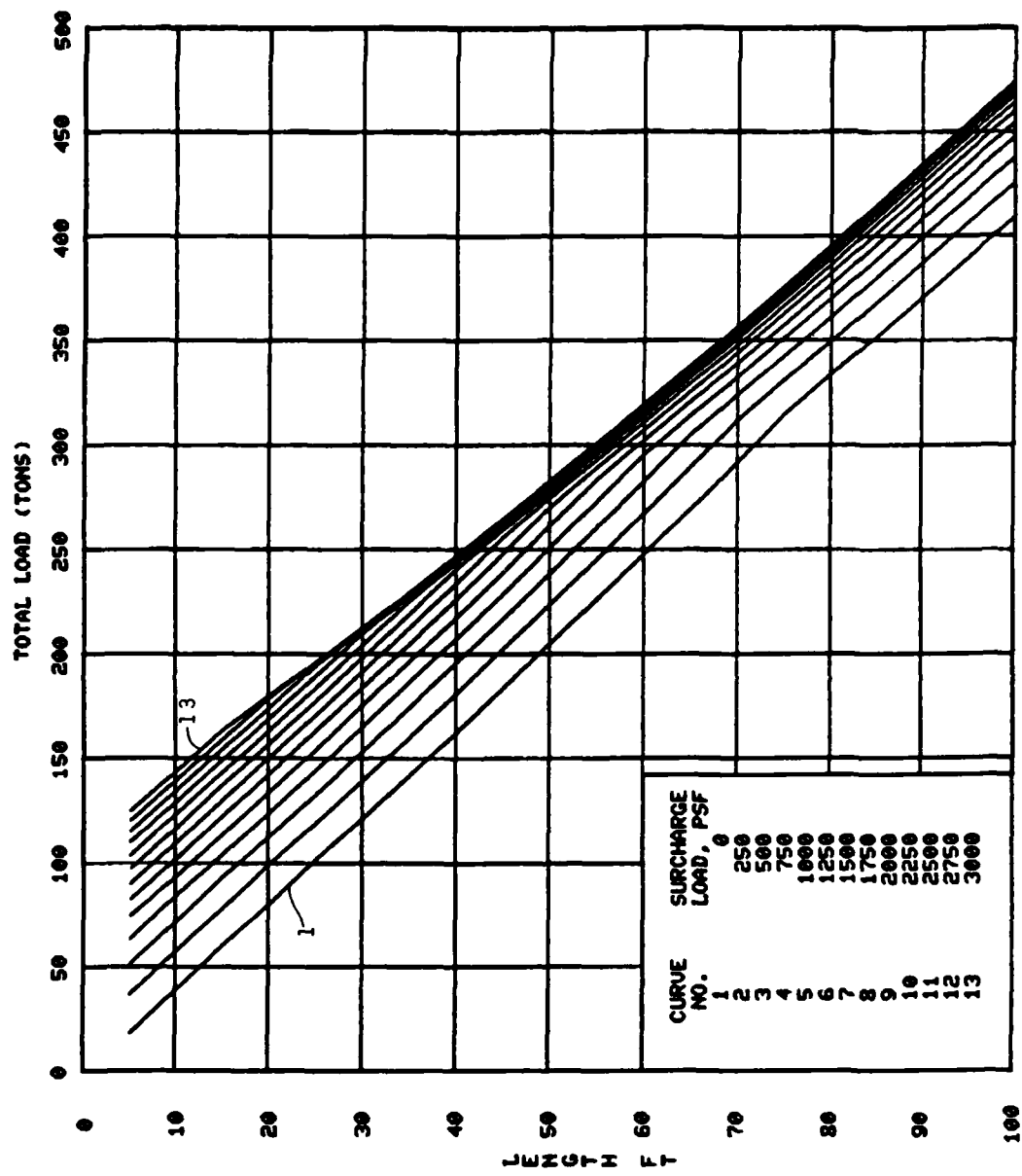


Figure 132. Total Pile Capacity For A 12-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi=37^\circ$ ,  $C=0$ .



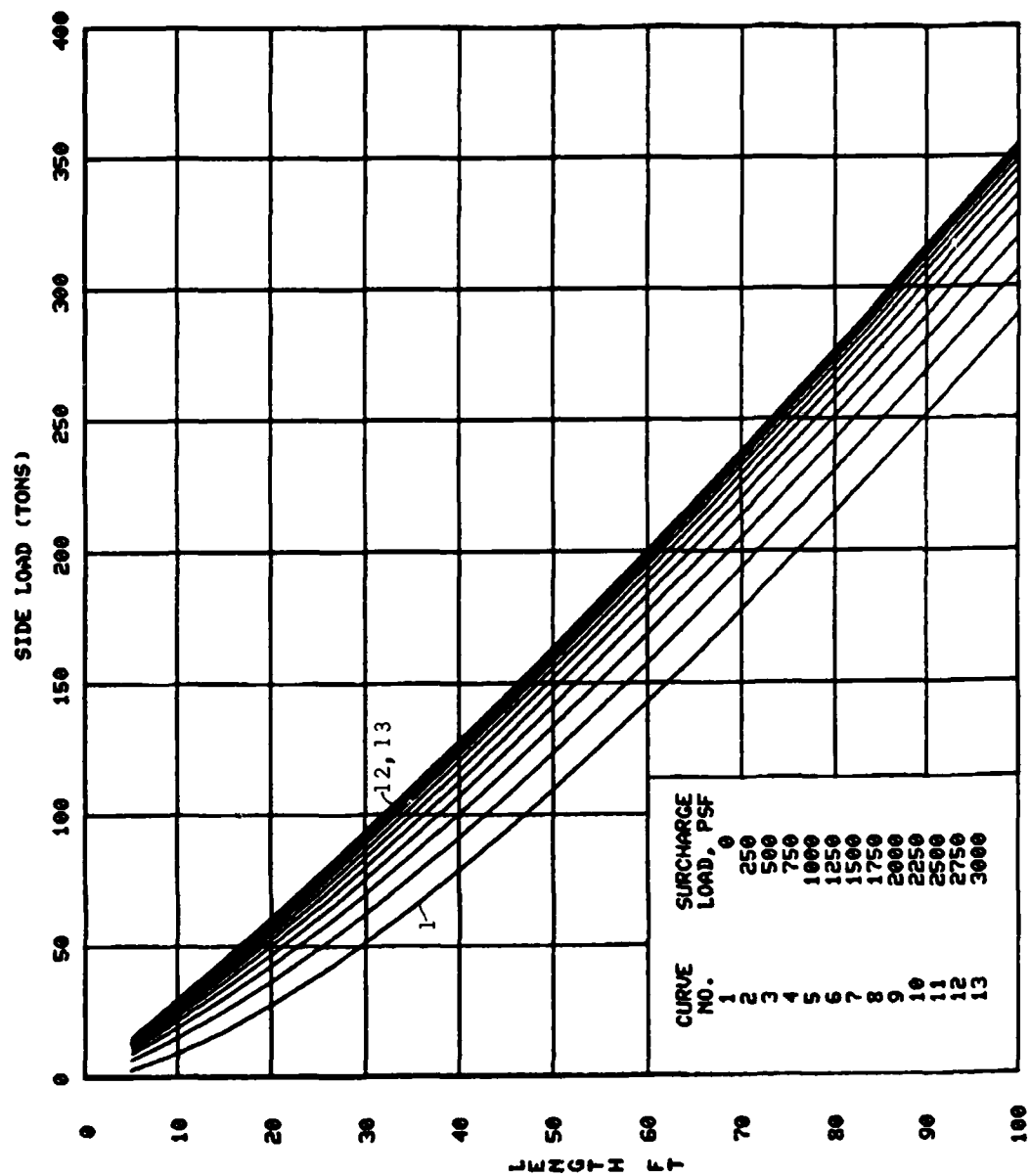


Figure 133. Side Capacity For A 12-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi$ 1-37 Deg., C-0.



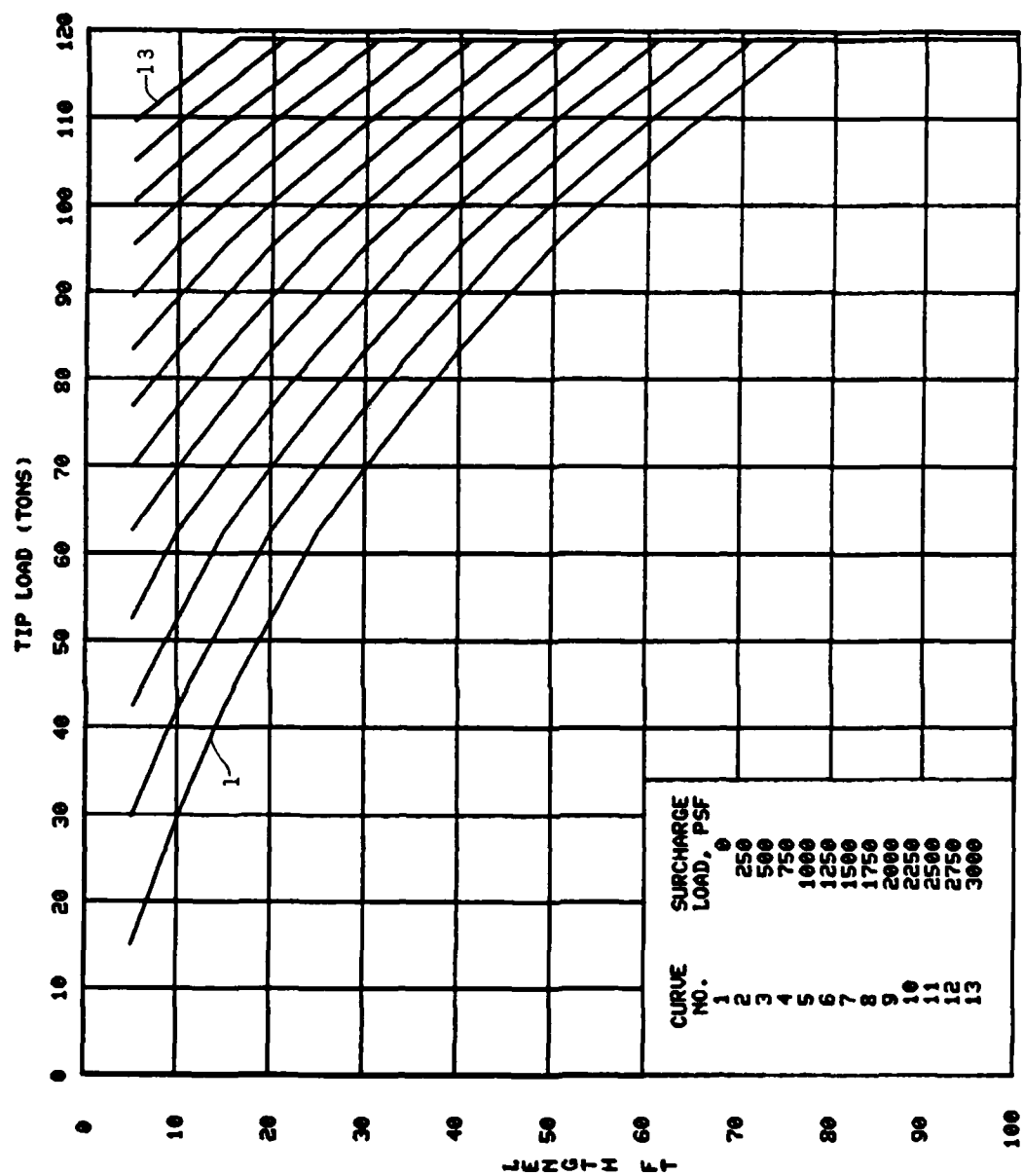


Figure 134. Tip Capacity For A 12-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi$ 1-37 Dag., C-0.



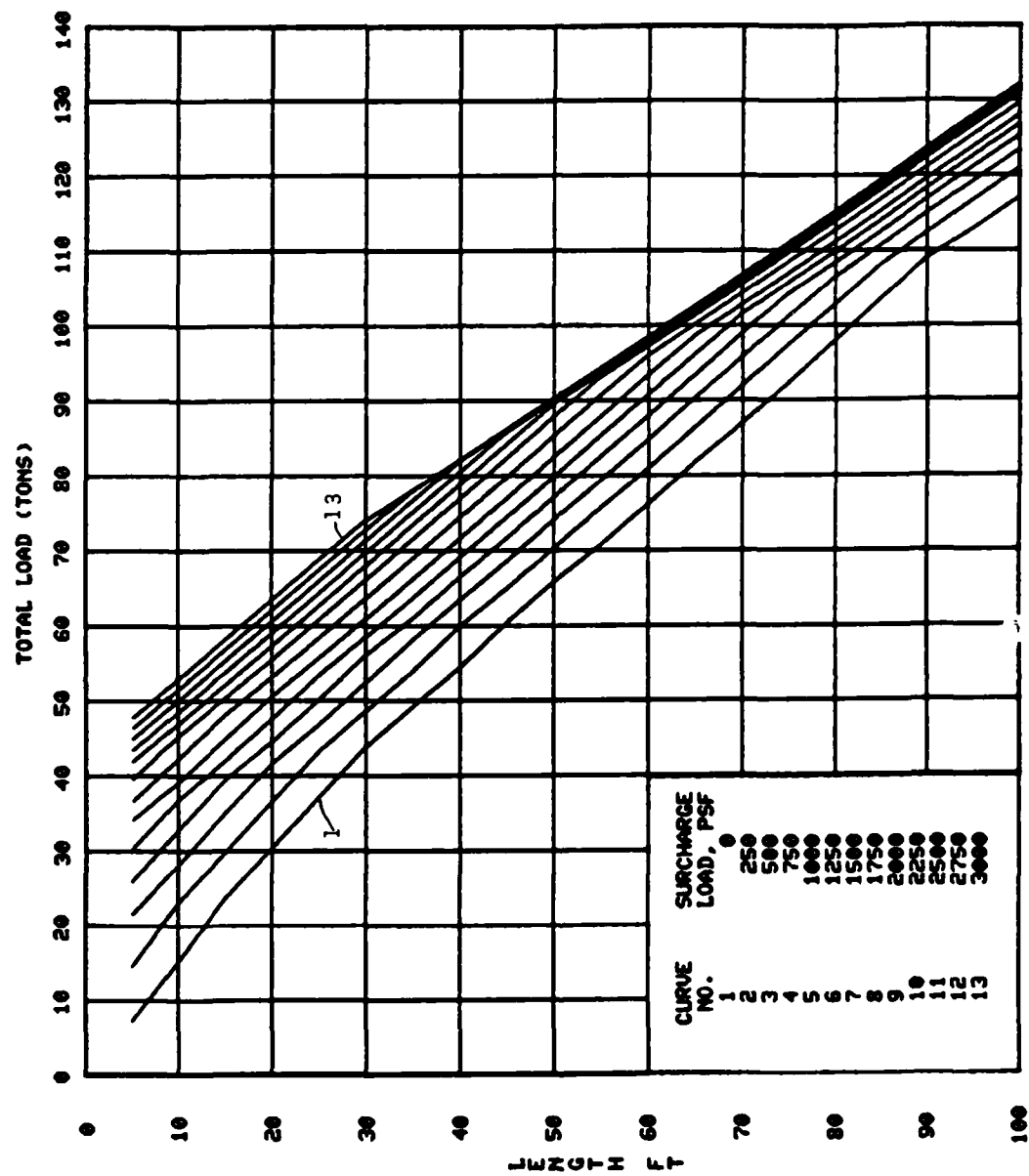


Figure 135. Total Pile Capacity For A 14-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi=30$  Deg.,  $C=0$ .



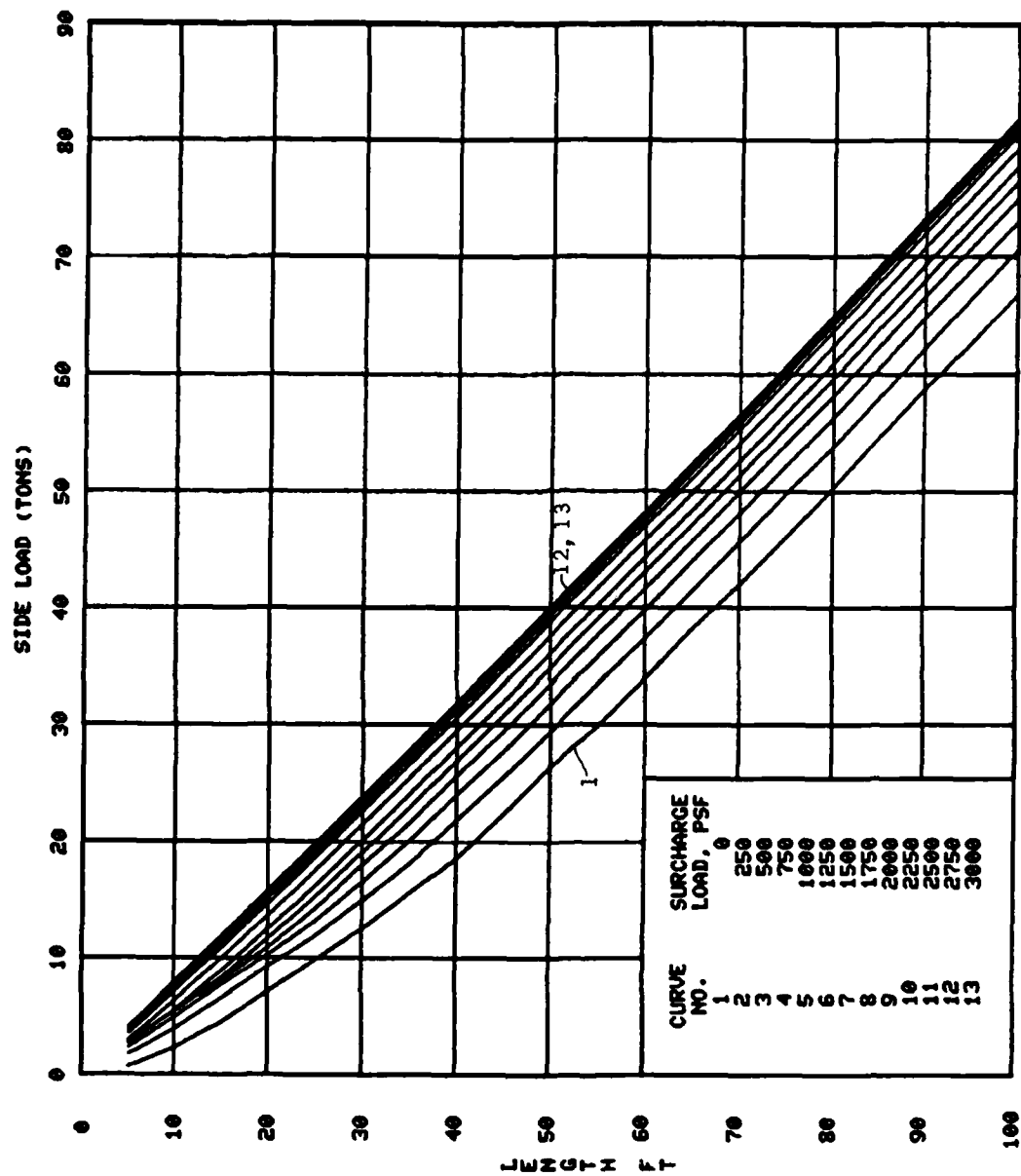


Figure 136. Side Capacity For A 14-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi=30$  Deg.,  $C=0$ .



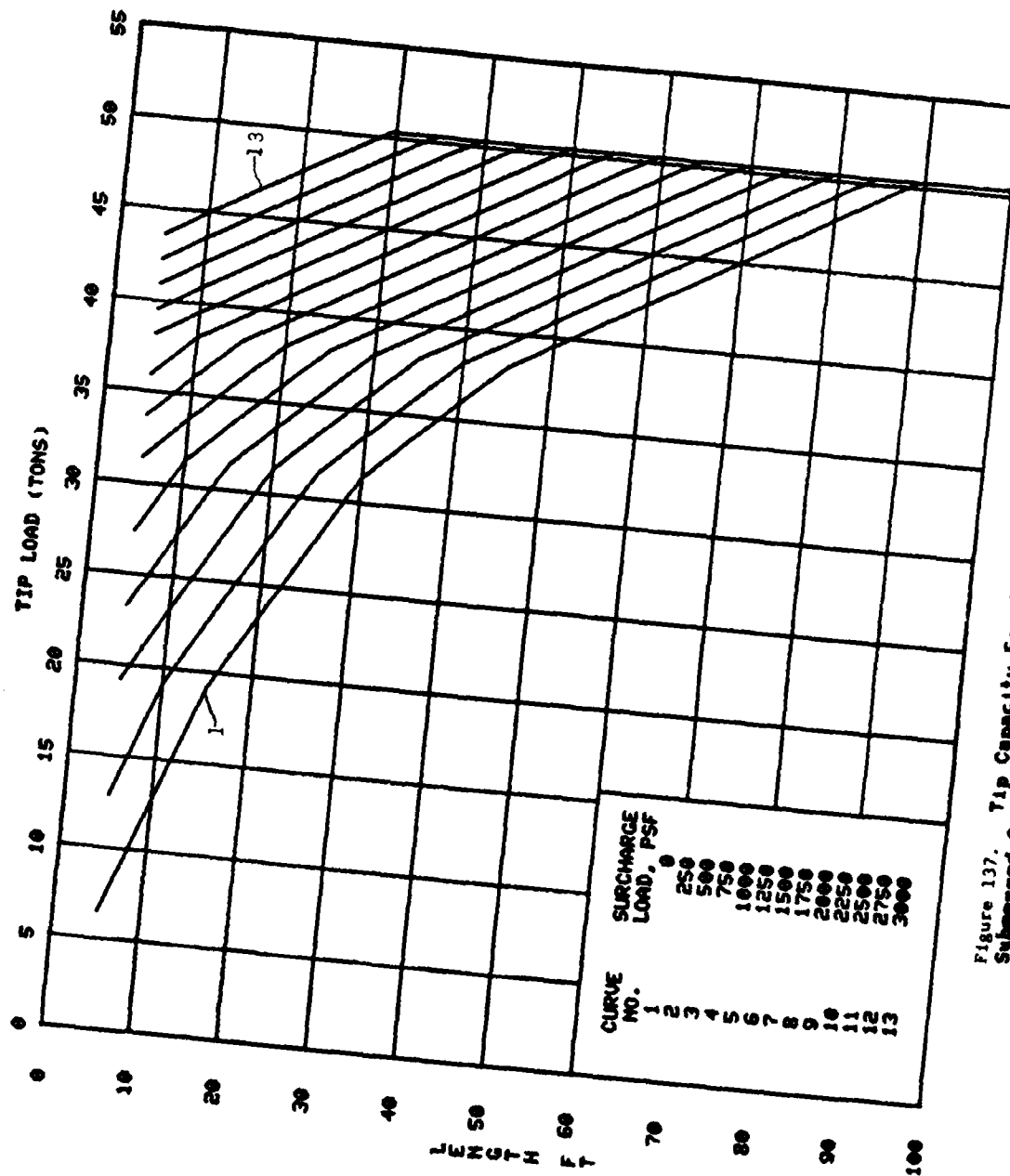


Figure 137. Tip Capacity For A 14-in Square Concrete Pile, Submerged Condition,  $1\frac{1}{4}$ -in. Tip Movement,  $\Phi=30$  Deg.,  $C=0$ .



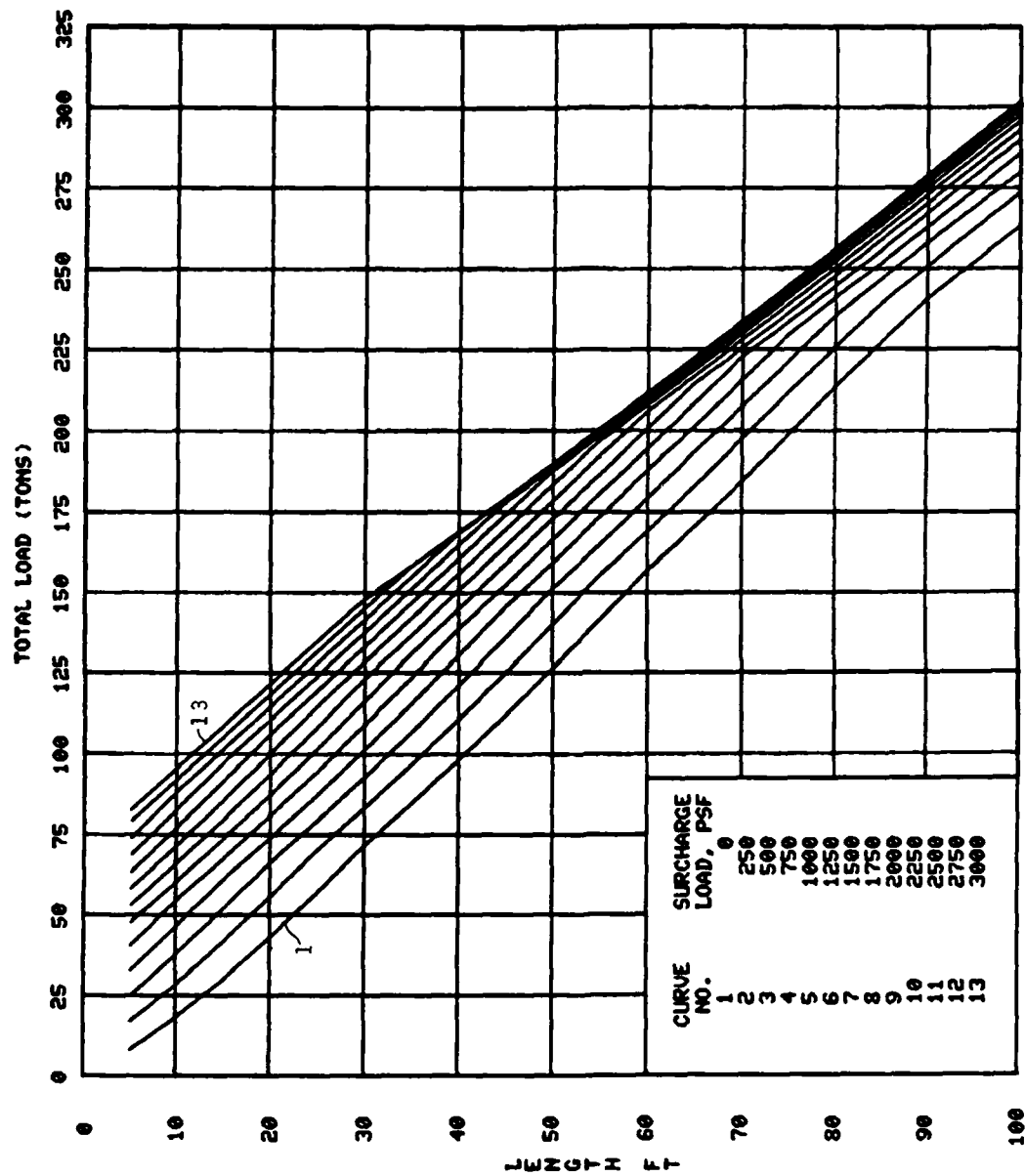


Figure 138. Total Pile Capacity For A 14-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi=33$  Deg.,  $C=0$ .



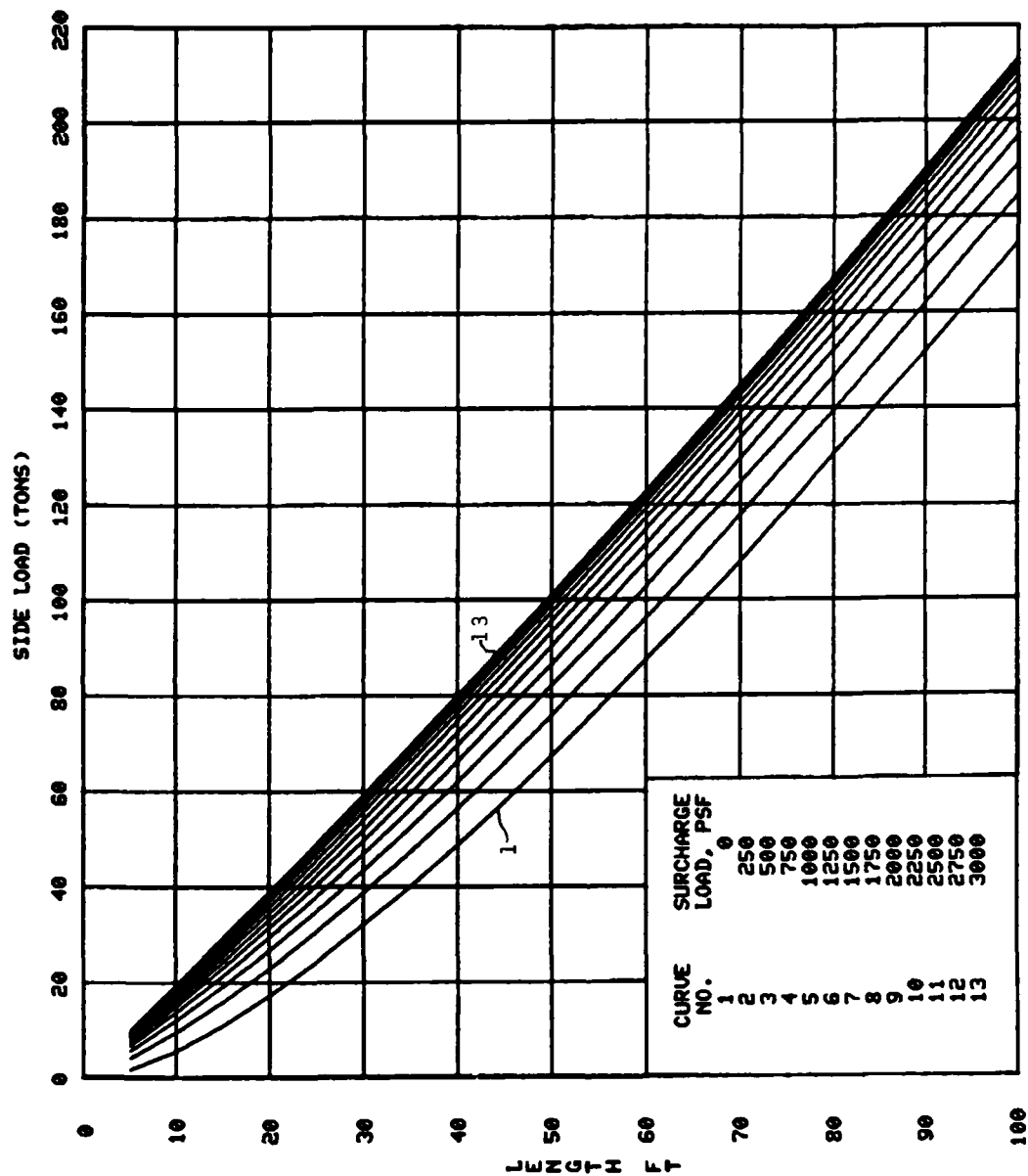


Figure 139. Side Capacity For A 14-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi$ 1-33 Deg., C-8.



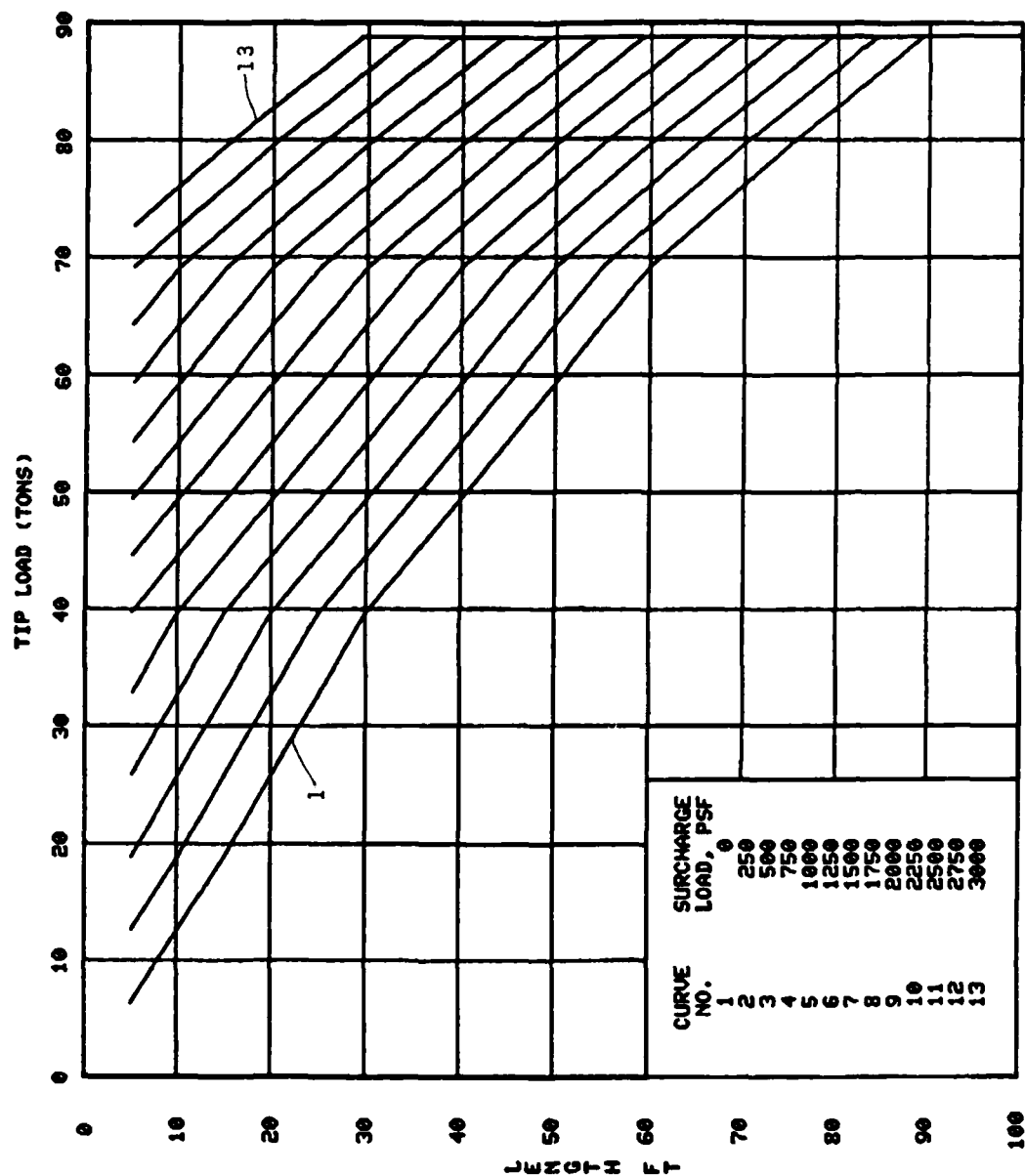


Figure 140. Tip Capacity For A 14-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\phi$ 1-33 Deg., C-6.



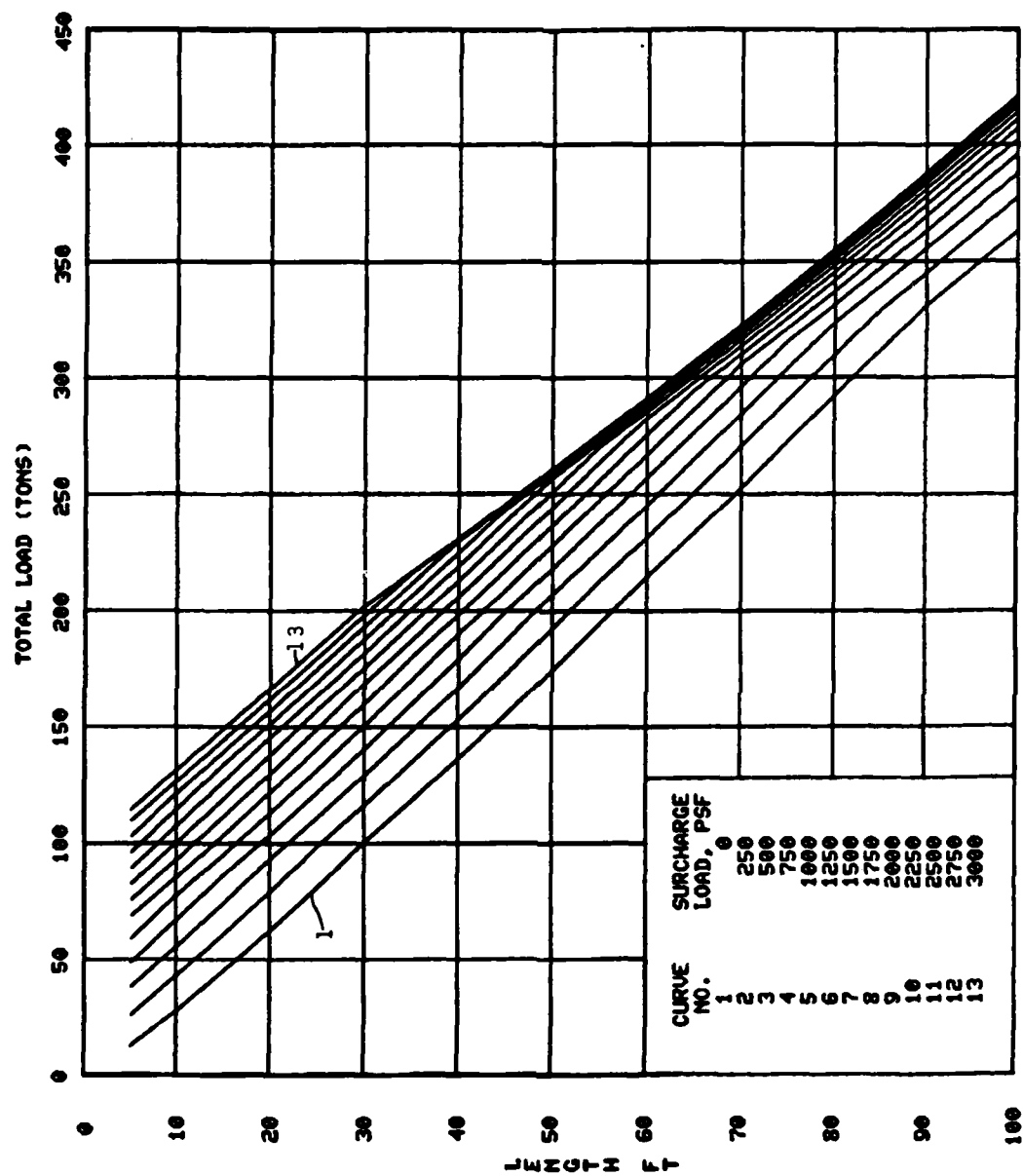


Figure 141. Total Pile Capacity For A 14-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\phi=35^\circ$ , C-6.



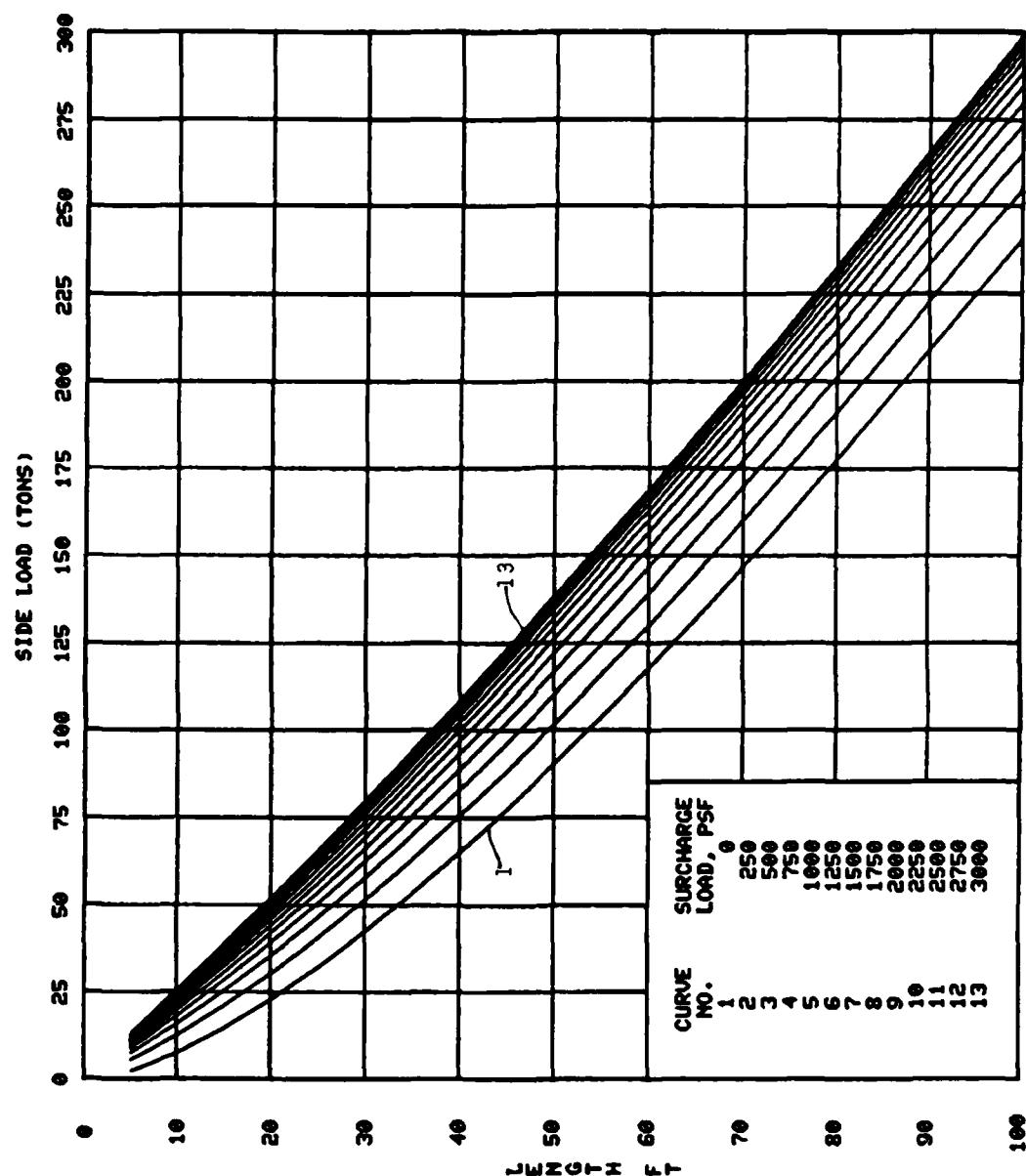


Figure 142. Side Capacity For A 14-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi=35^\circ$ , C-0.



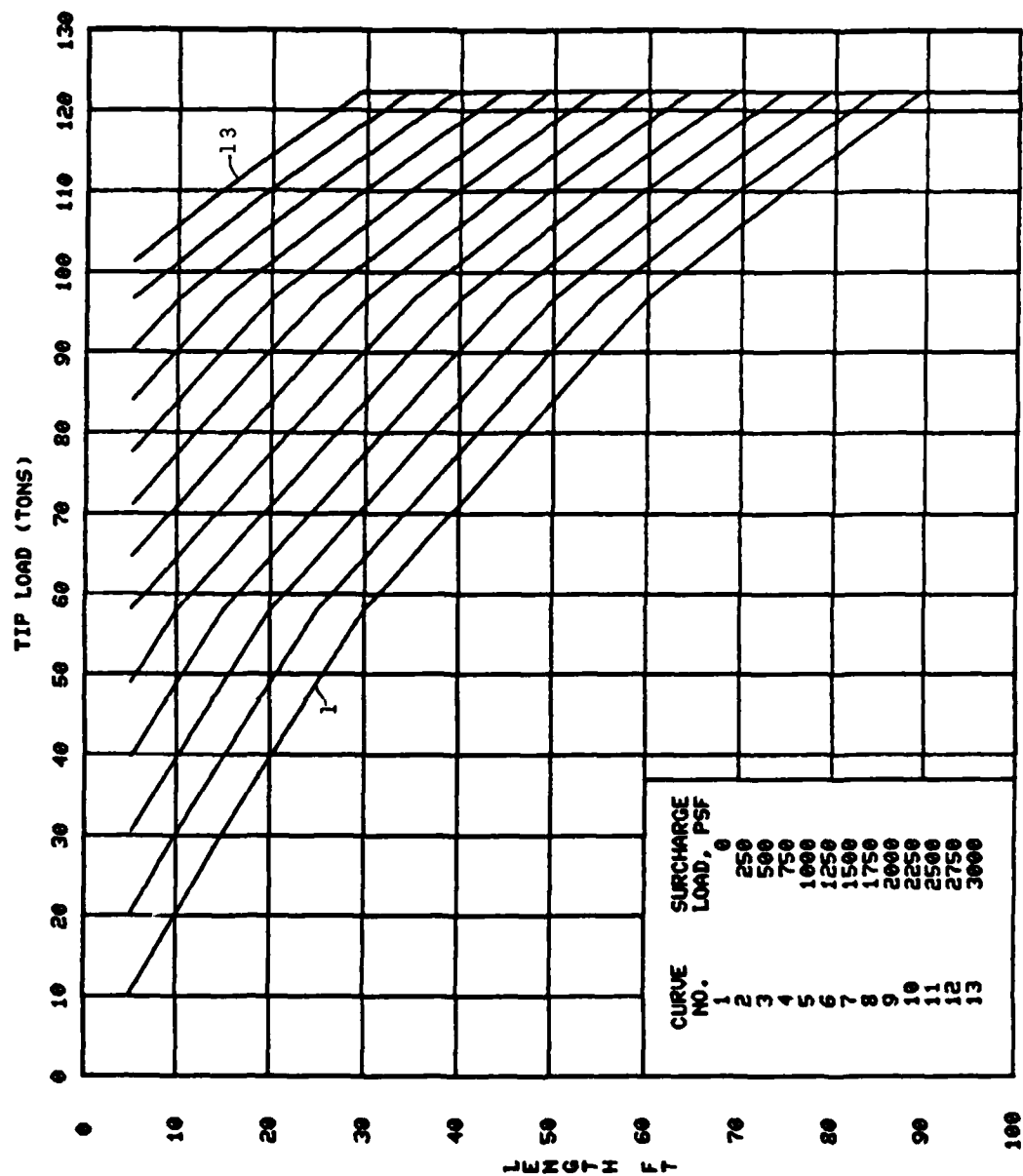


Figure 143. Tip Capacity For A 14-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi=35$  Deg., C-0.



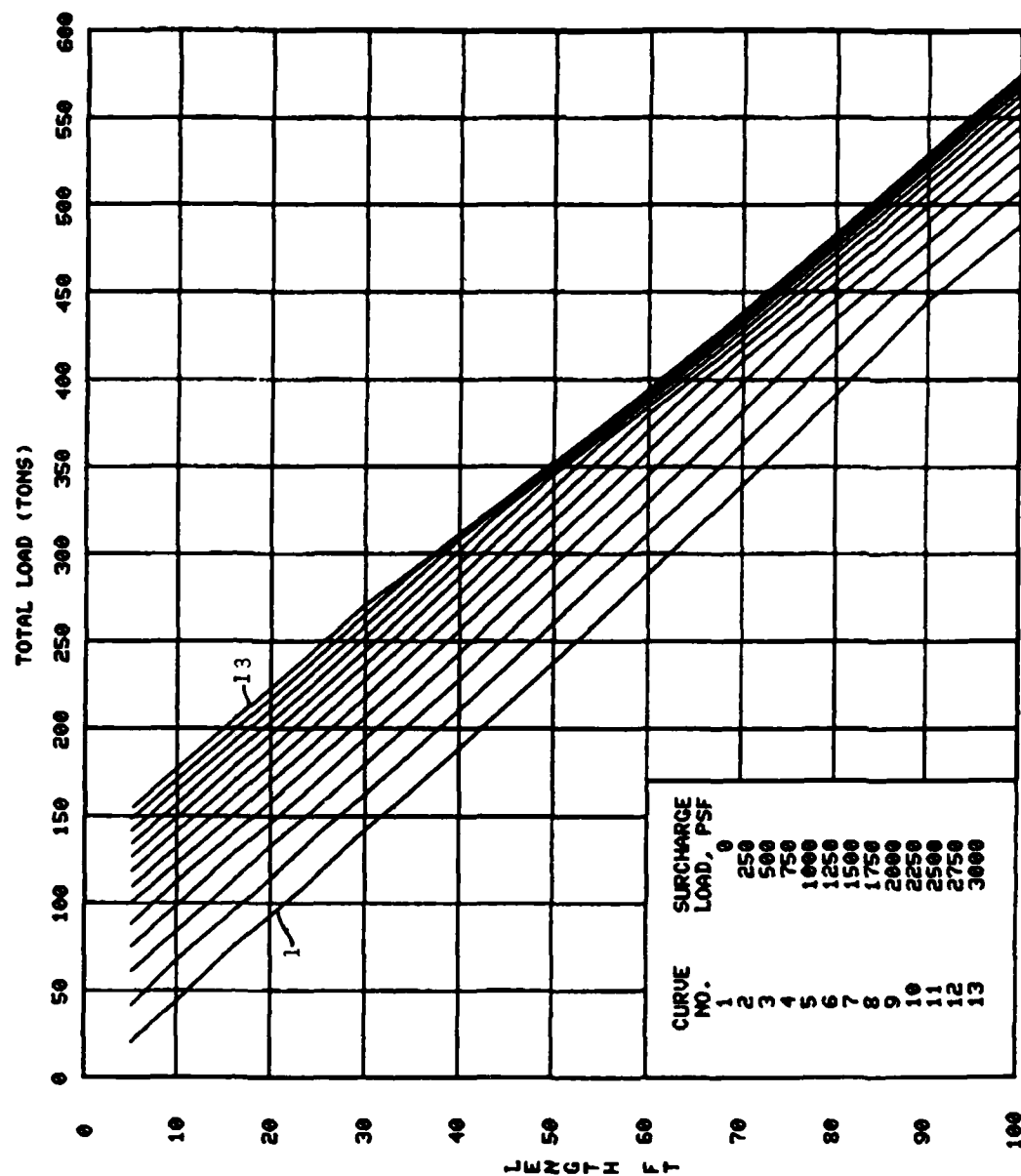


Figure 144. Total Pile Capacity For A 14-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi=37^\circ$  Deg.,  $C=0$ .



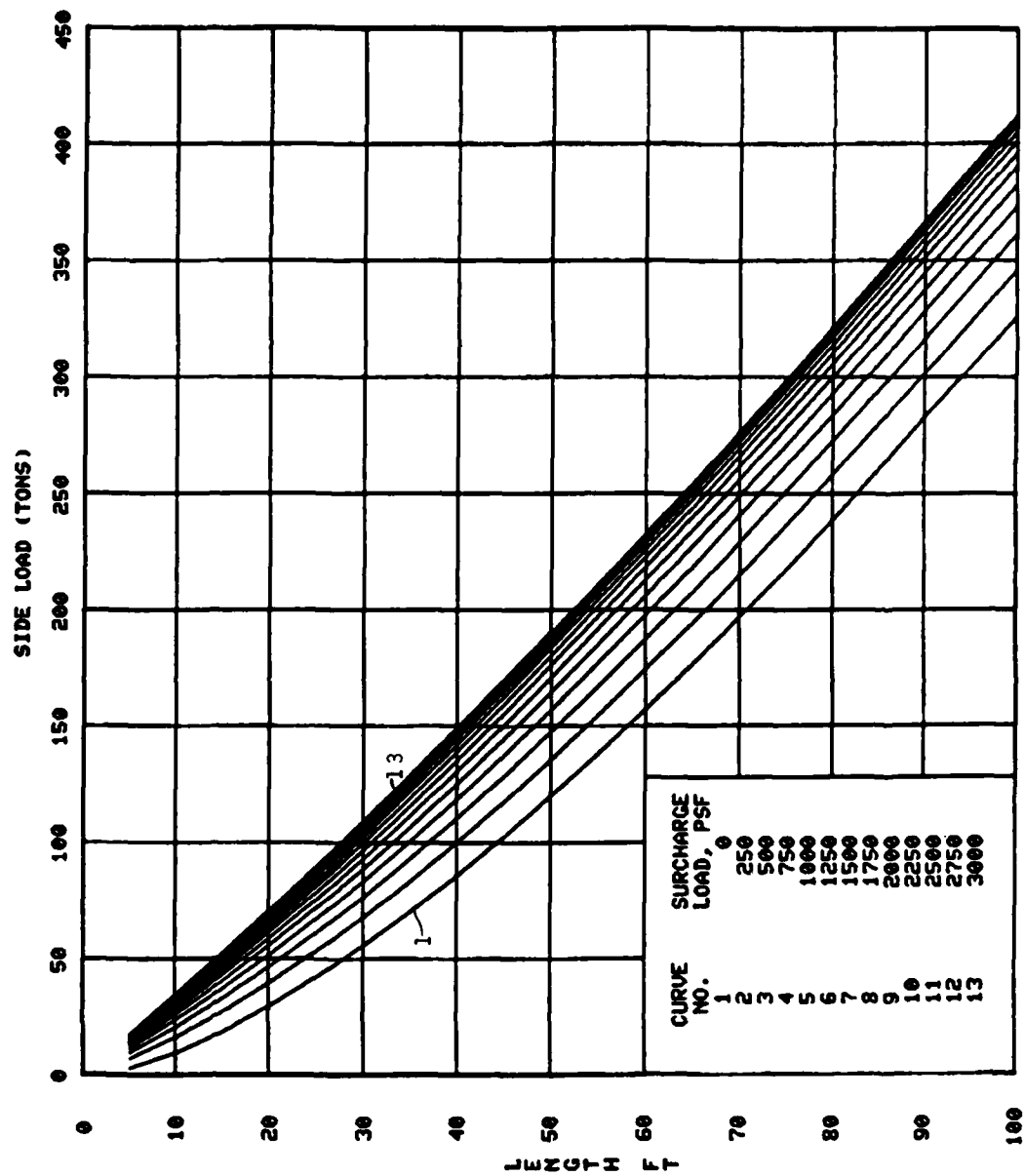


Figure 145. Side Capacity For A 14-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\phi=37$  Deg., C-0.



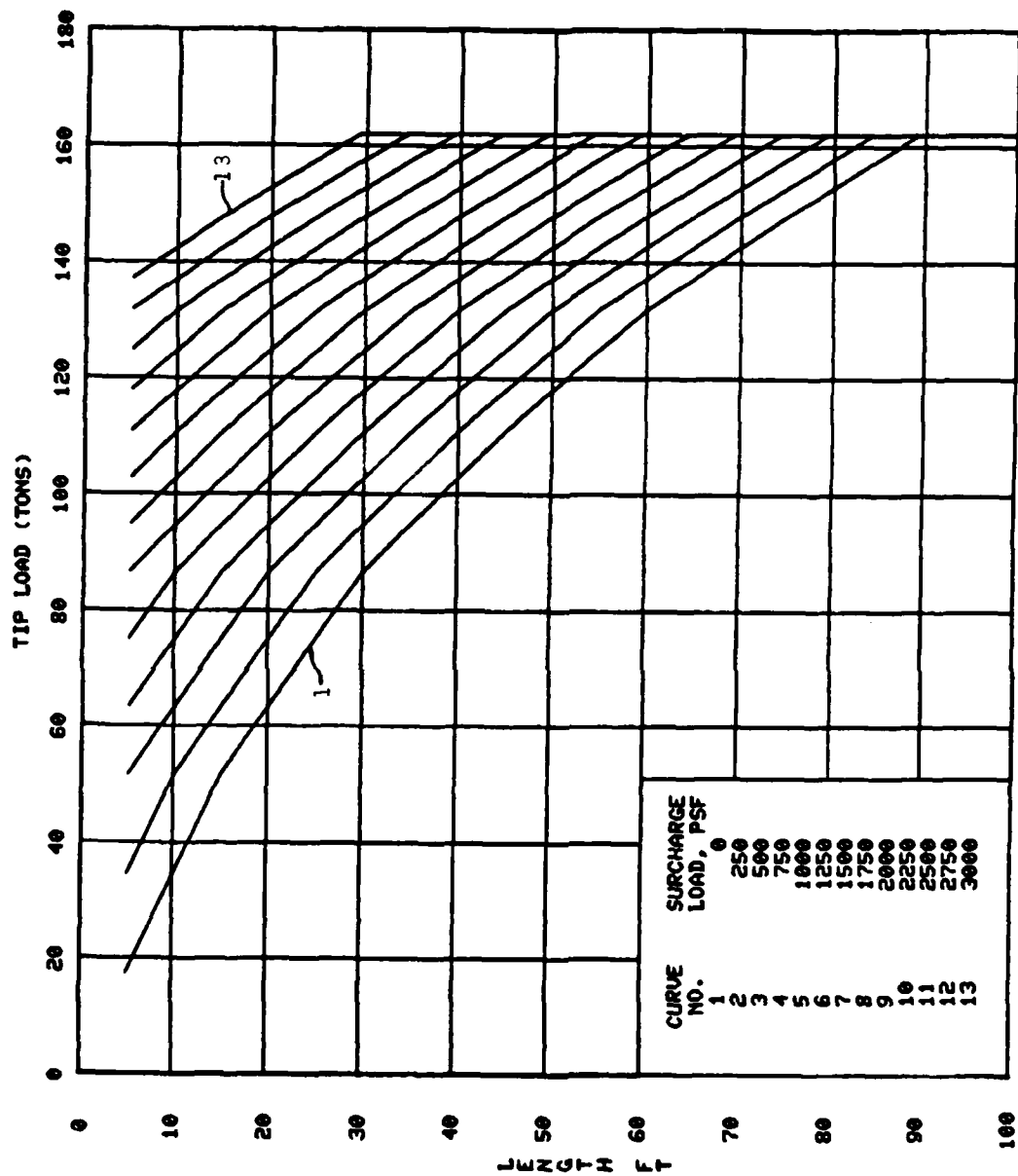


Figure 146. Tip Capacity For A 14-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\phi = 37^\circ$ , C-0.



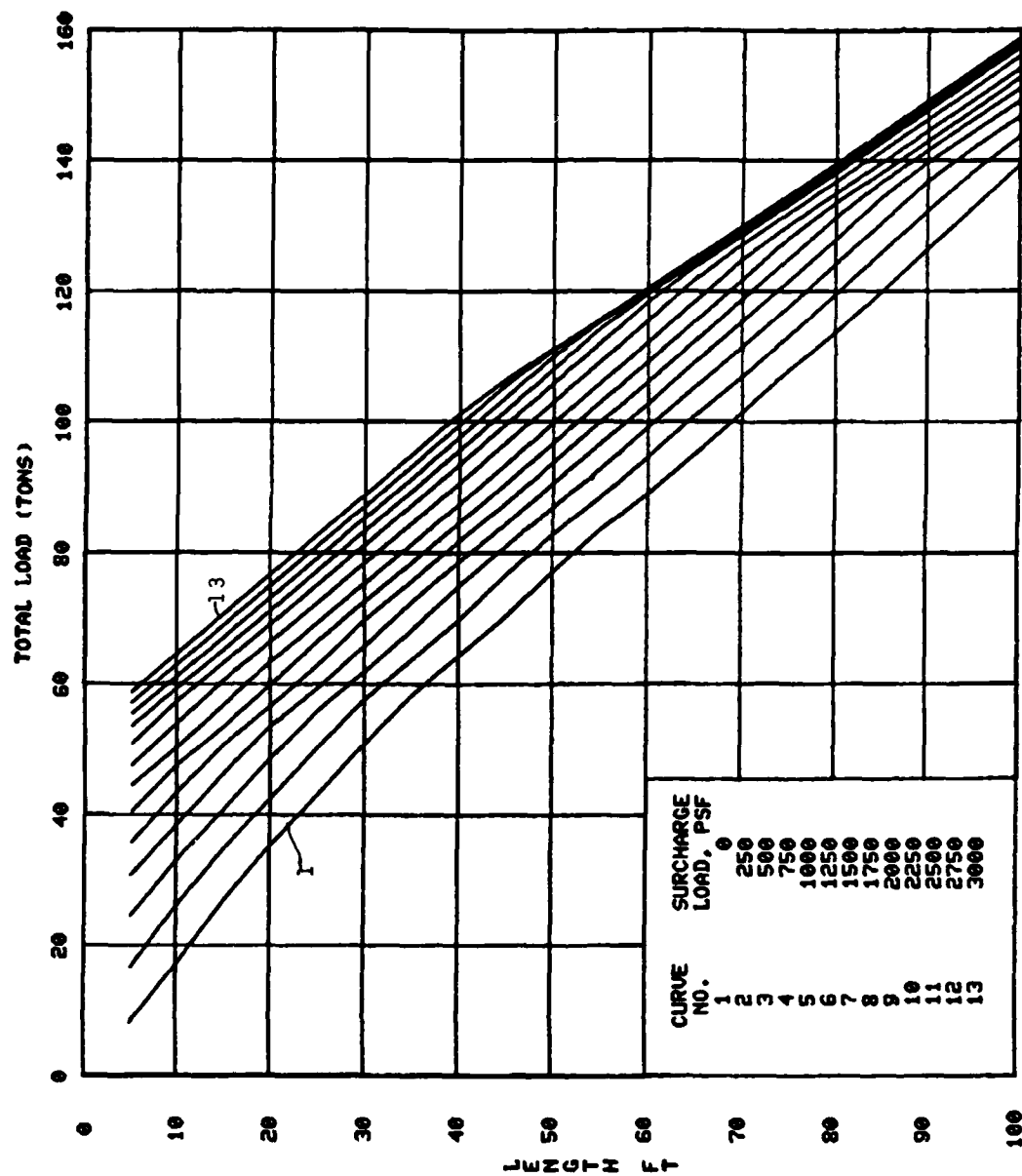


Figure 147. Total Pile Capacity For A 16-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\phi=30^\circ$ , C-0.



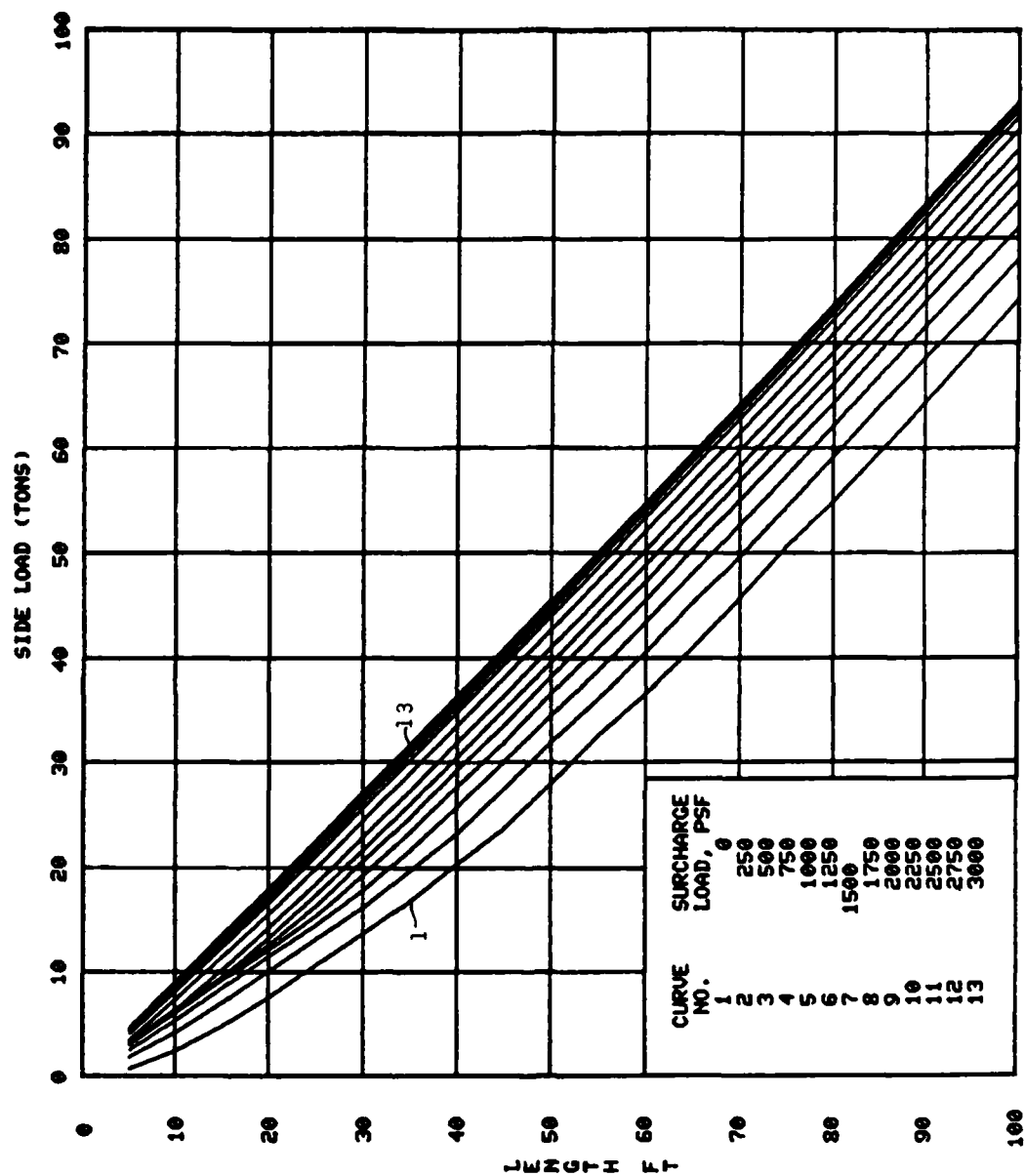


Figure 148. Side Capacity For A 16-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi=30$  Deg., C-0.



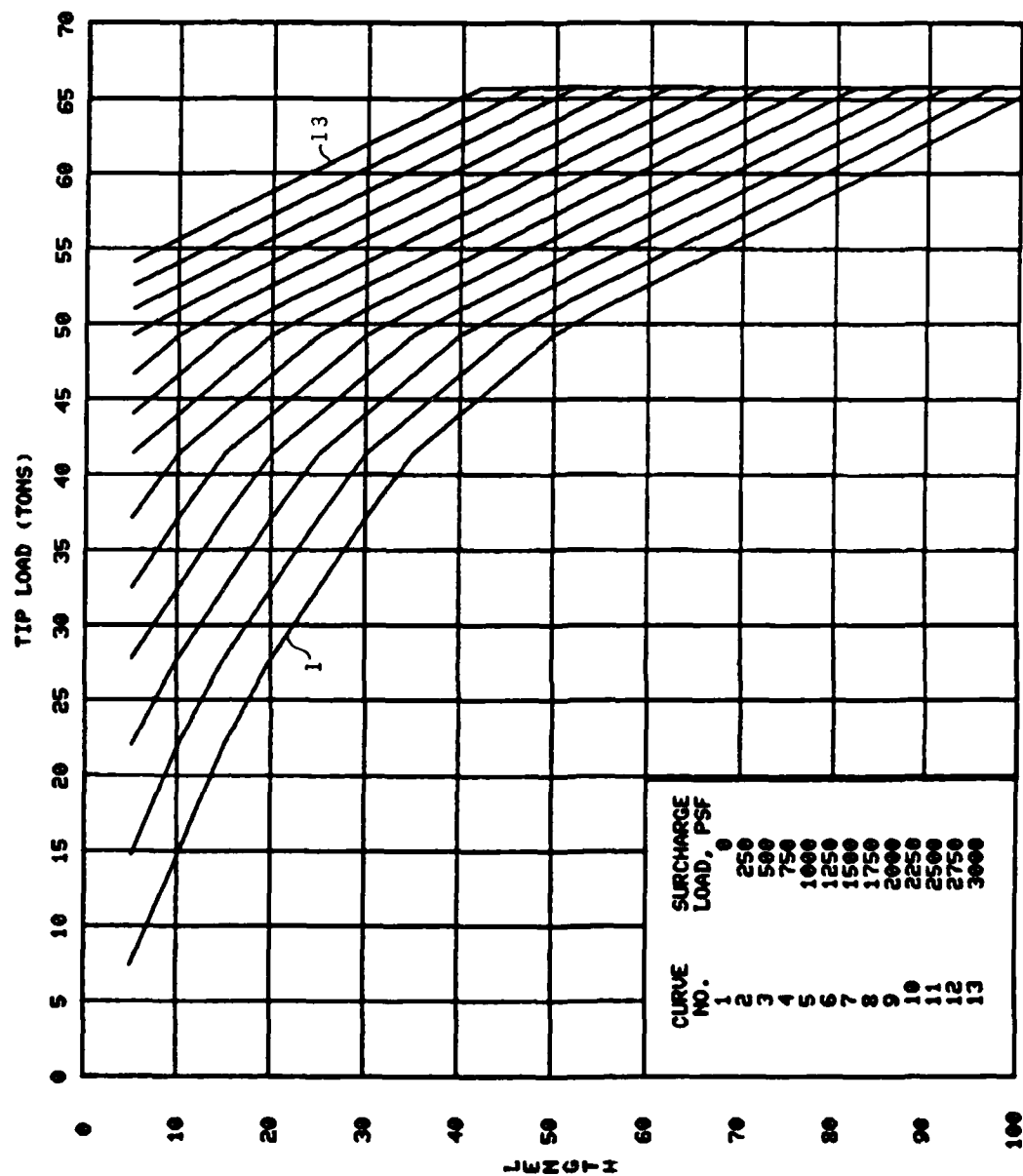


Figure 149. Tip Capacity For A 16-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi=30$  Deg., C-0.



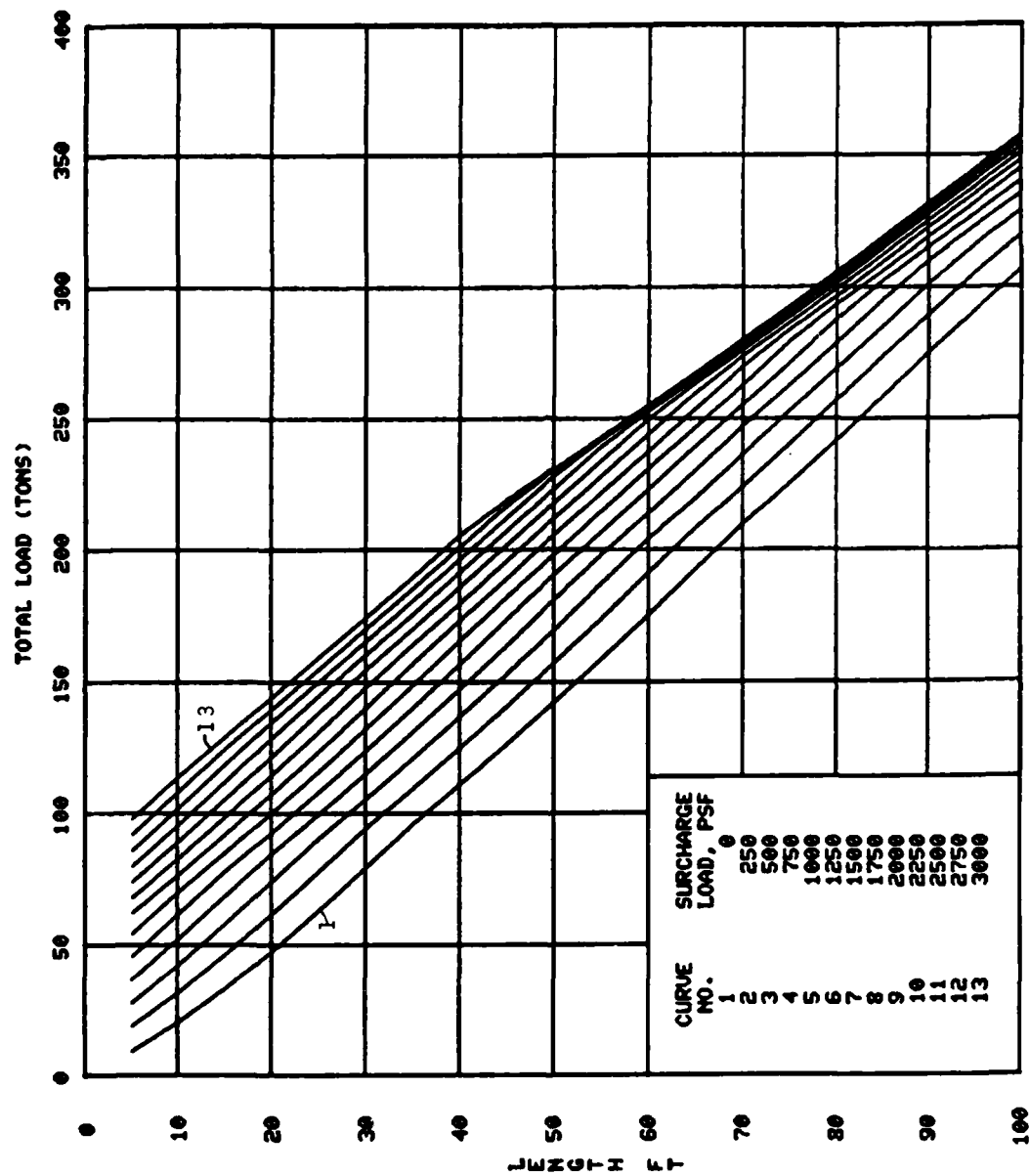


Figure 150. Total Pile Capacity For A 16-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi$ 1-33 Deg., C-0.



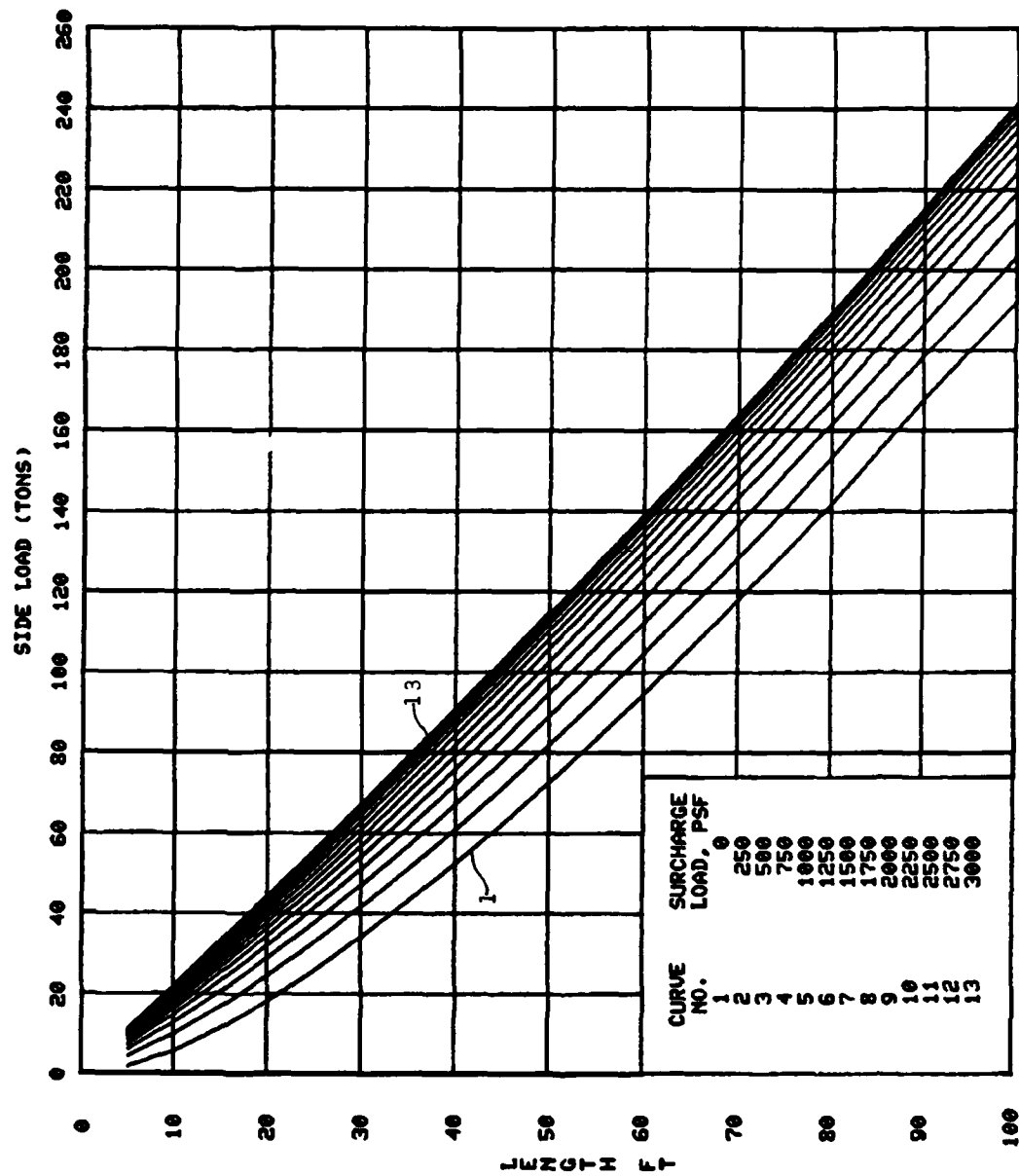


Figure 151. Side Capacity For A 16-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi$ 1-33 Deg., C-0.



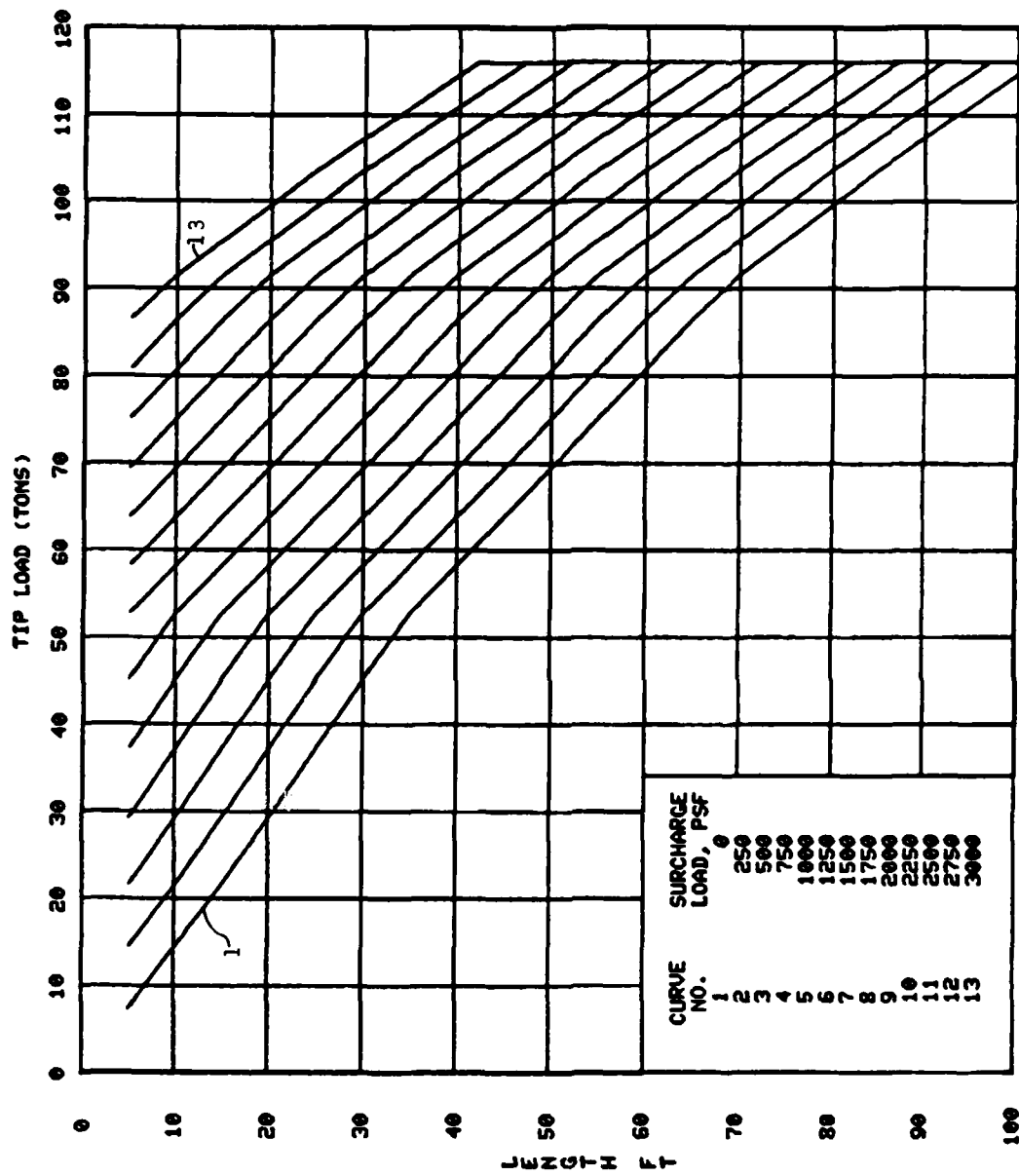


Figure 152. Tip Capacity For A 15-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement, Phi-33 Dag., C-0.



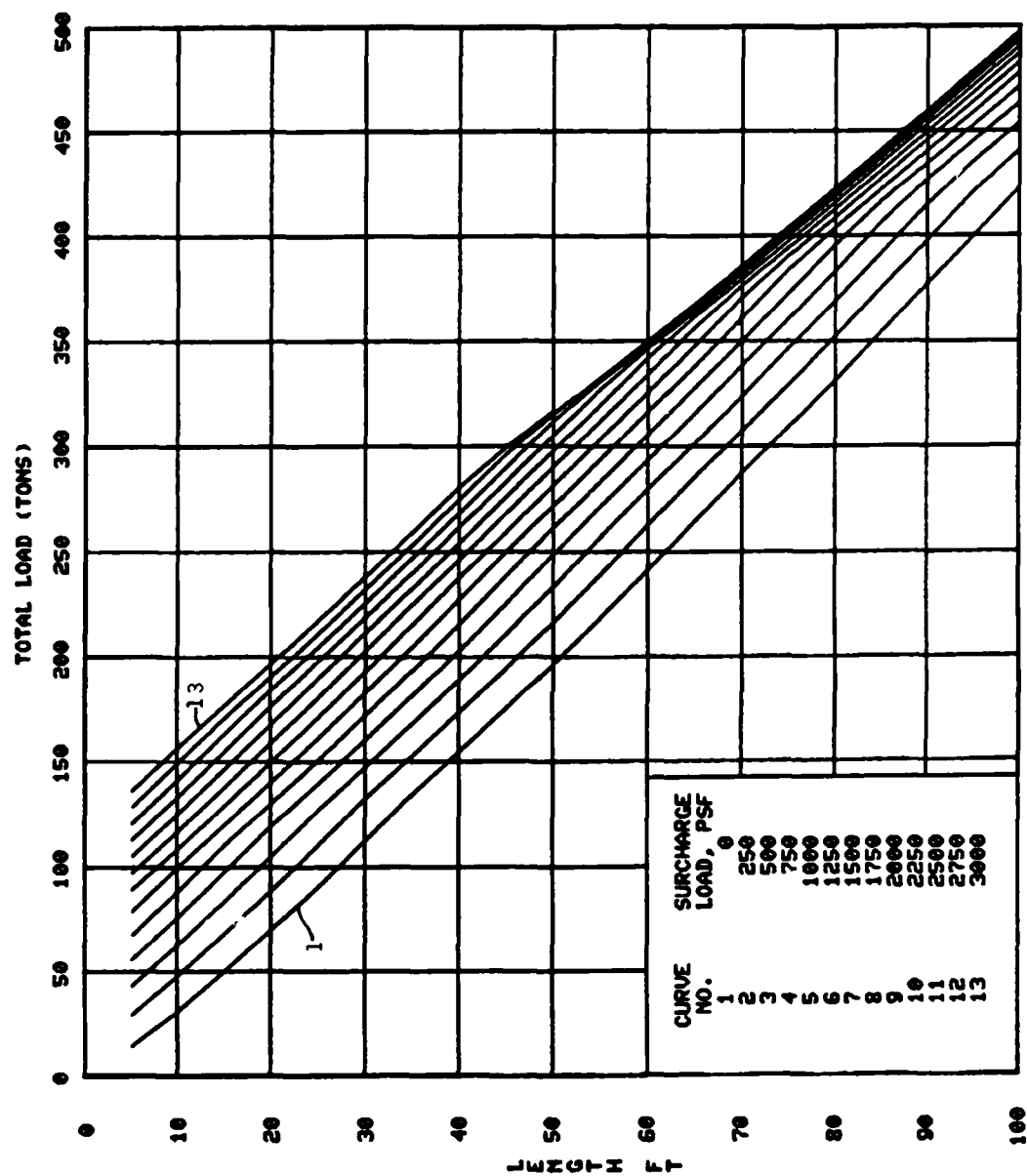


Figure 153. Total Pile Capacity For A 16-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\phi = 35^\circ$ , C-0.



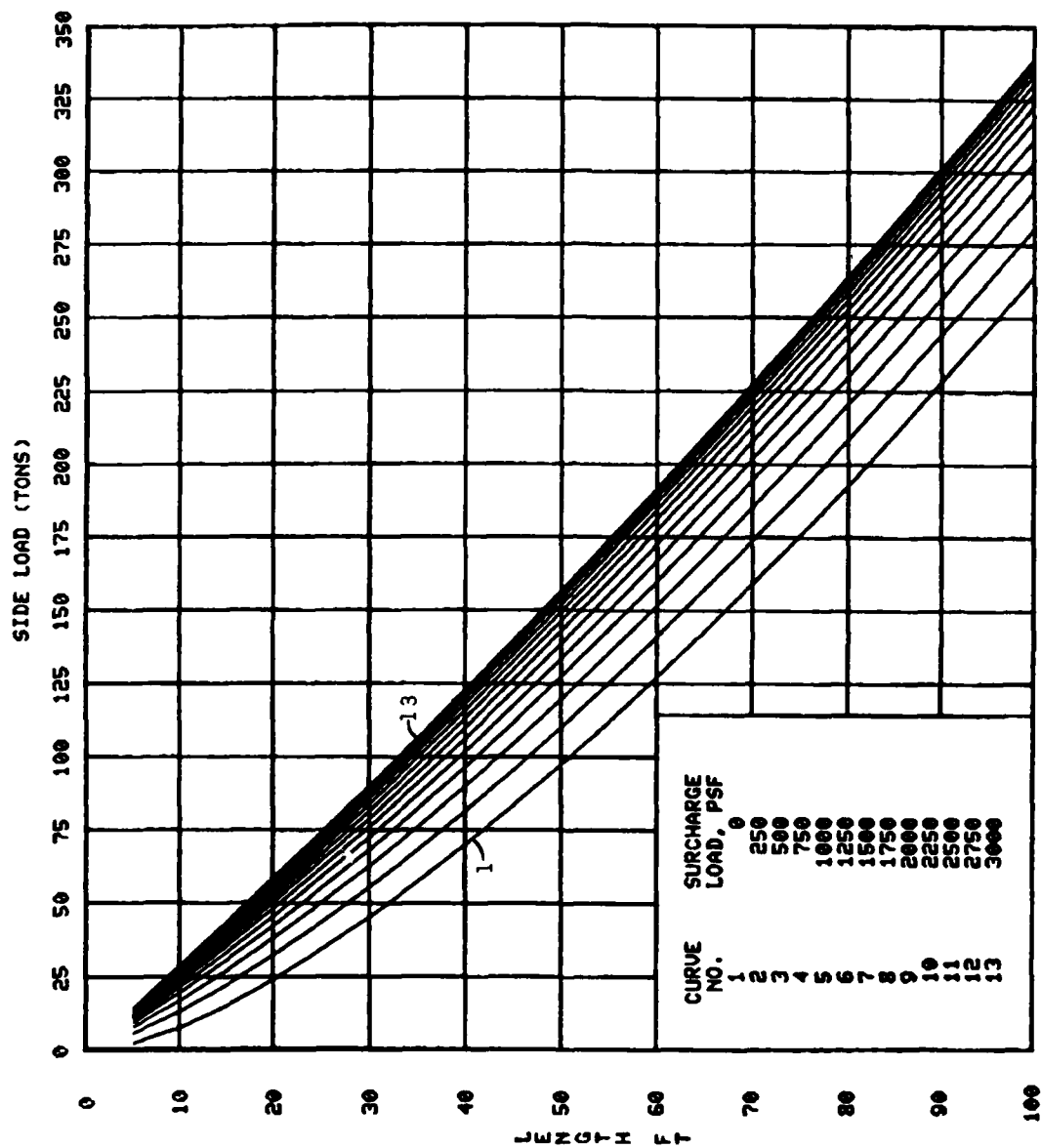


Figure 154. Side Capacity For A 16-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi=35^\circ$ ,  $C=0$ .



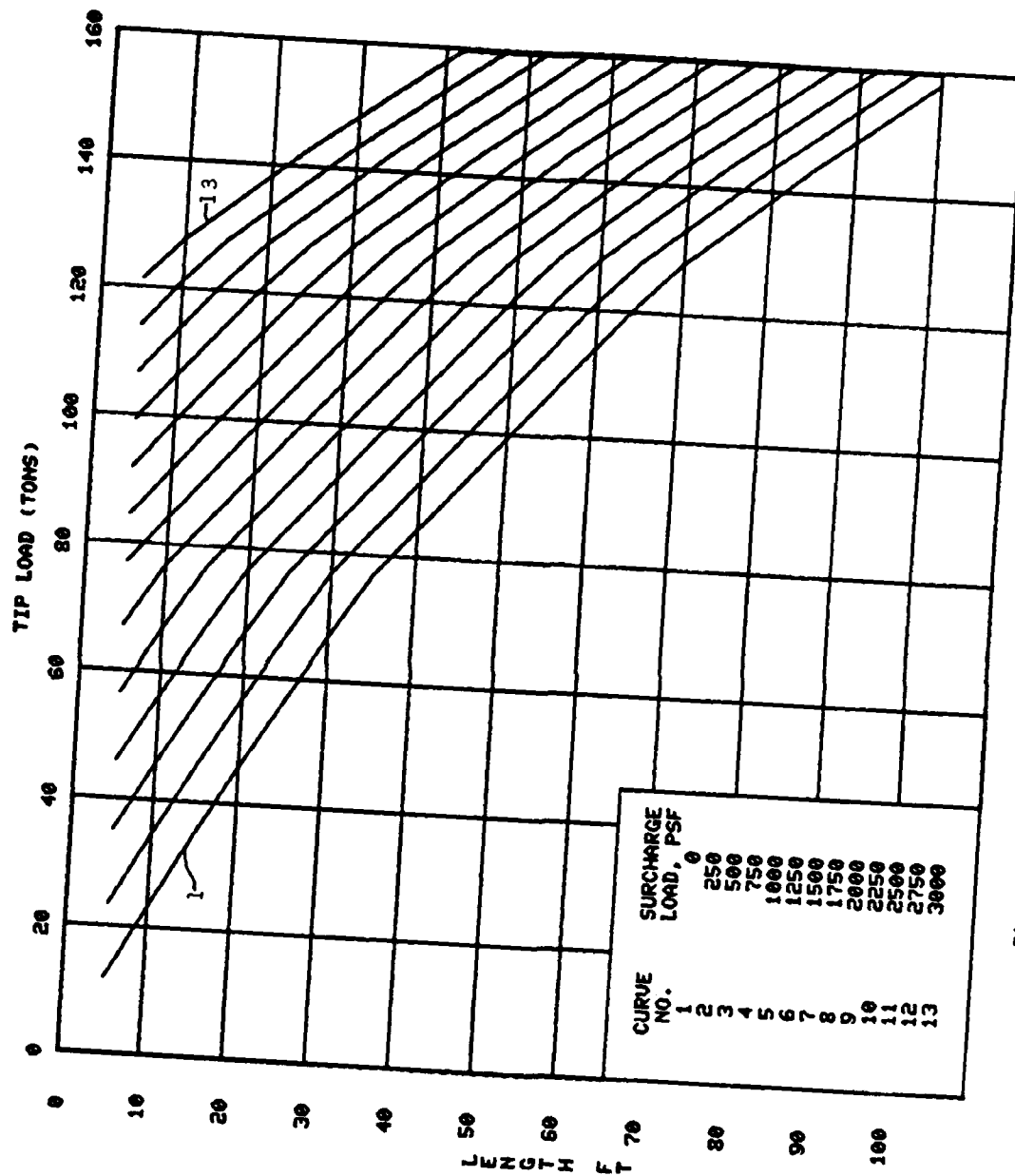


Figure 155. Tip Capacity For A 16-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi=35^\circ$ ,  $C=0$ .



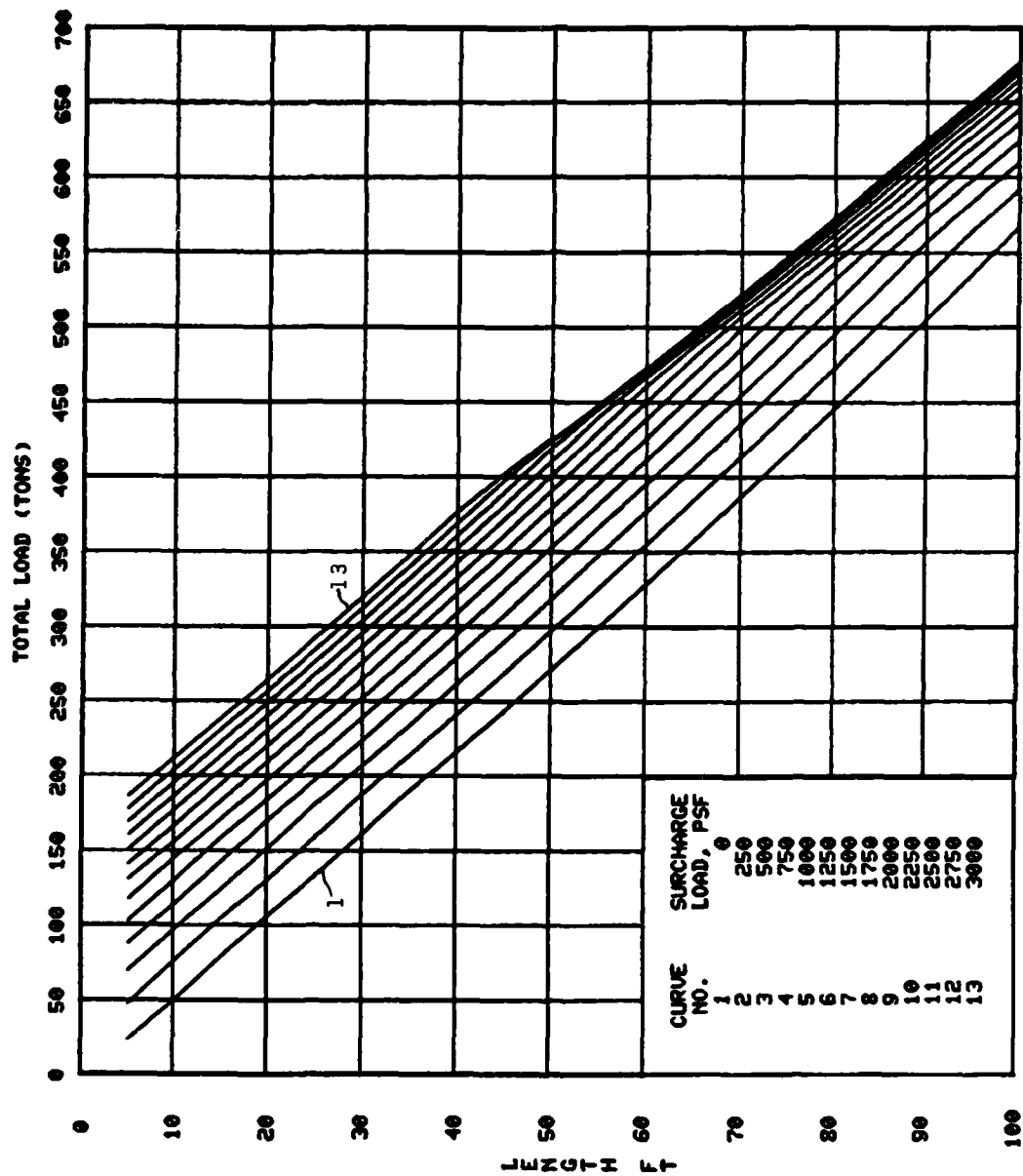


Figure 156. Total Pile Capacity For A 16-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\phi=37^\circ$ , C-0.



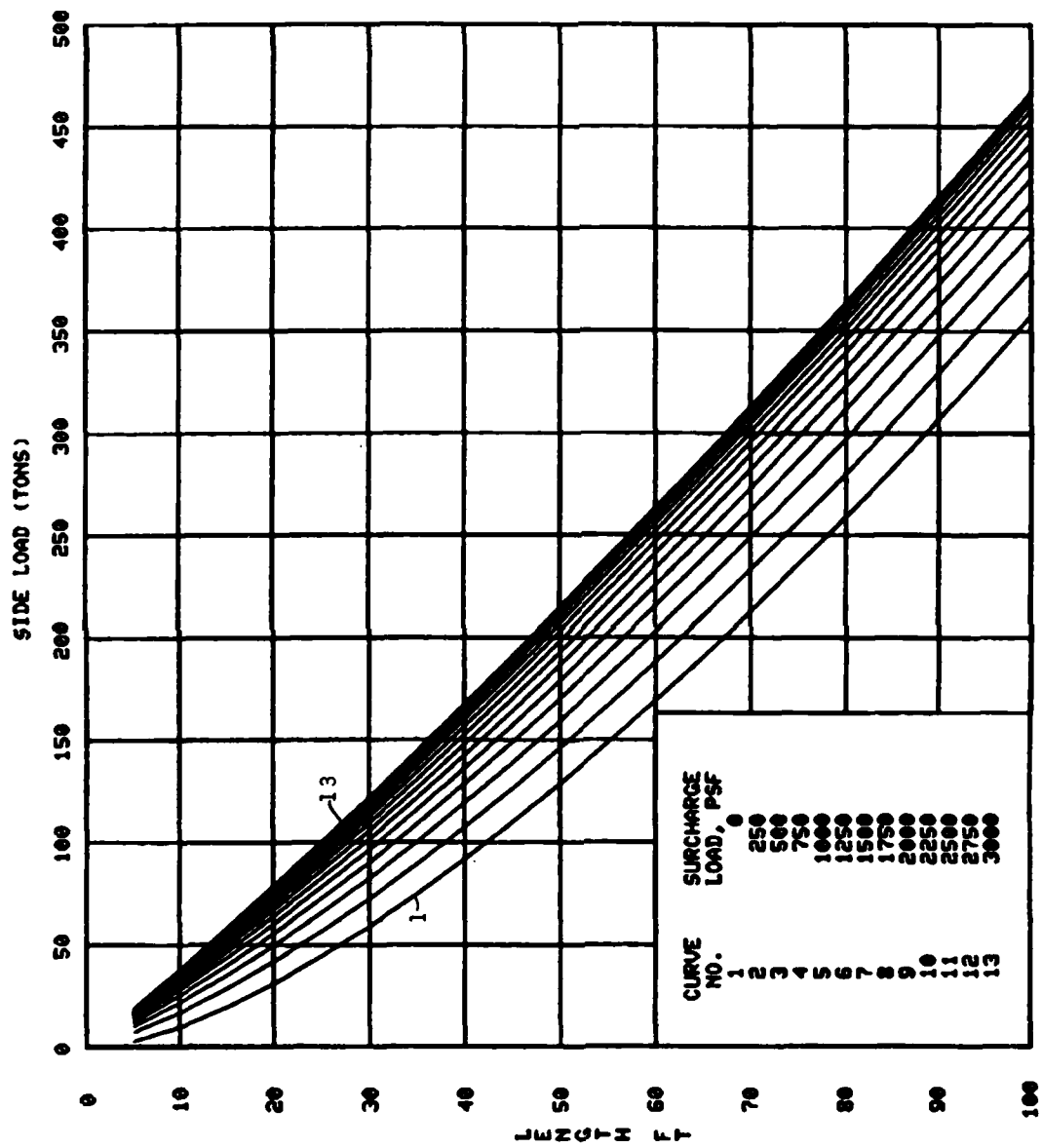


Figure 157. Side Capacity For A 16-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\phi_{1-37}$  Deg., C-6.



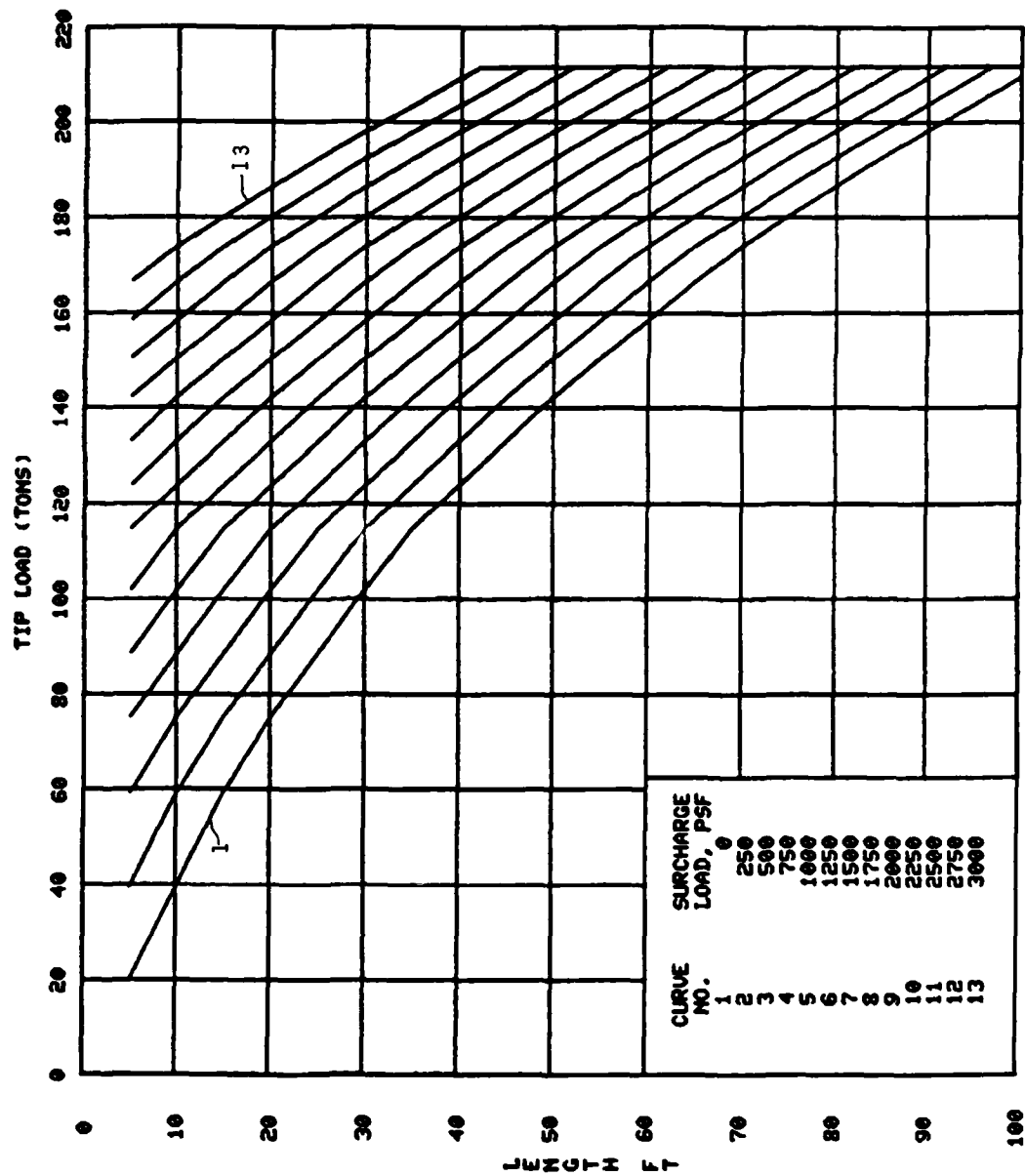


Figure 158. Tip Capacity For A 16-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement, Phi-37 Dag., C-0.



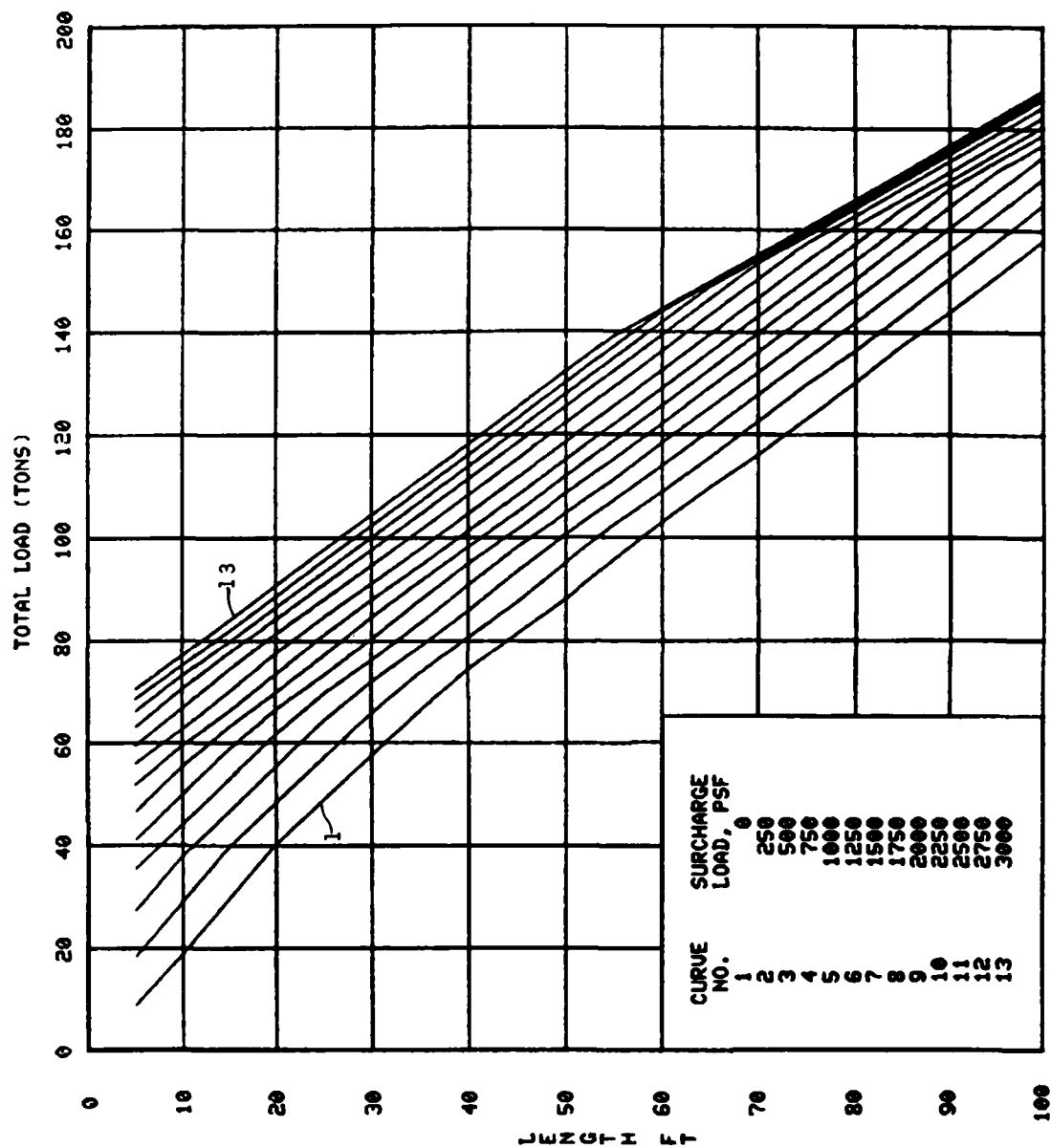


Figure 159. Total Pile Capacity For A 18-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi=30$  Deg.,  $C=0$ .



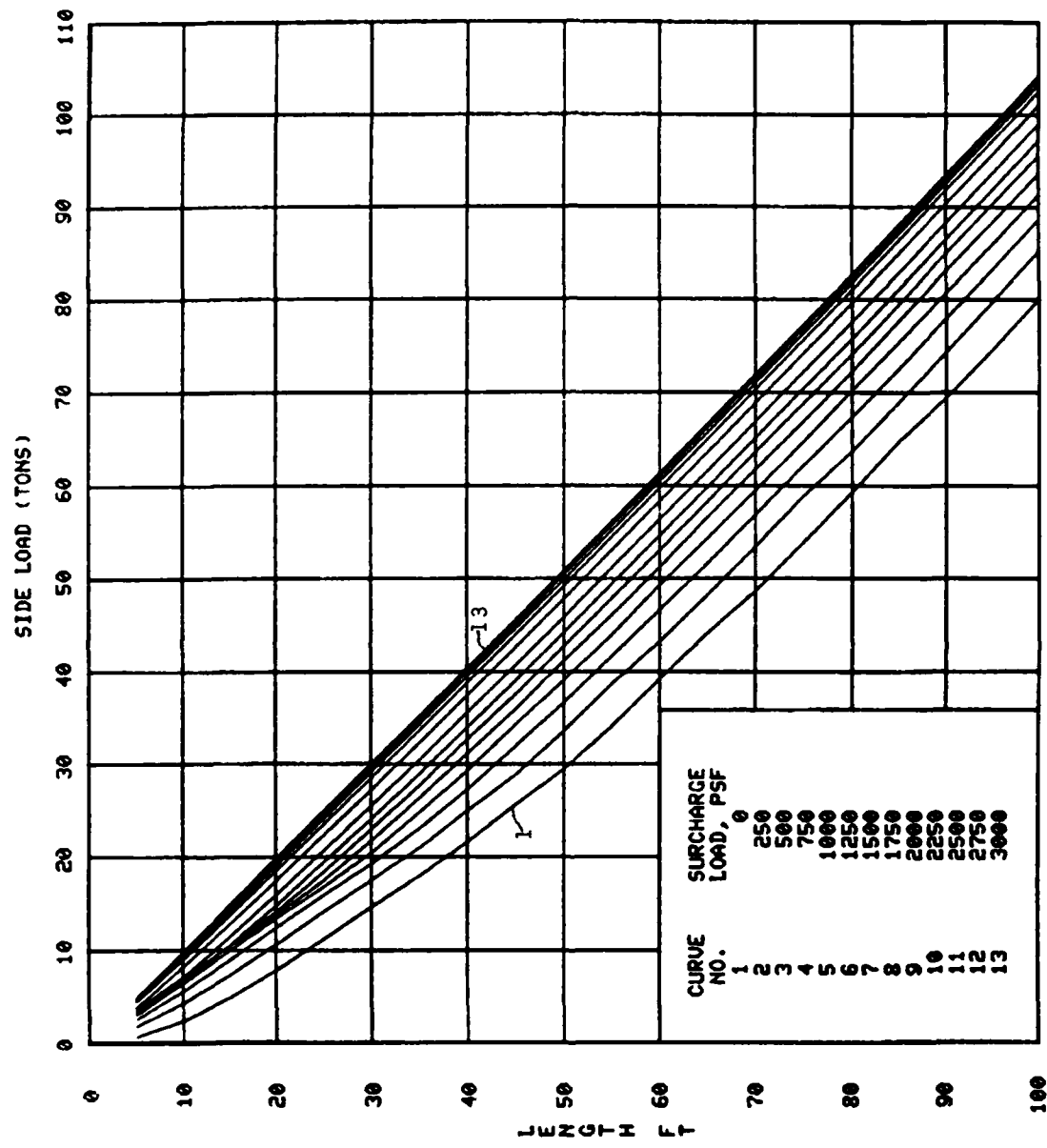


Figure 160. Side Capacity For A 18-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi=30$  Deg.,  $C=0$ .



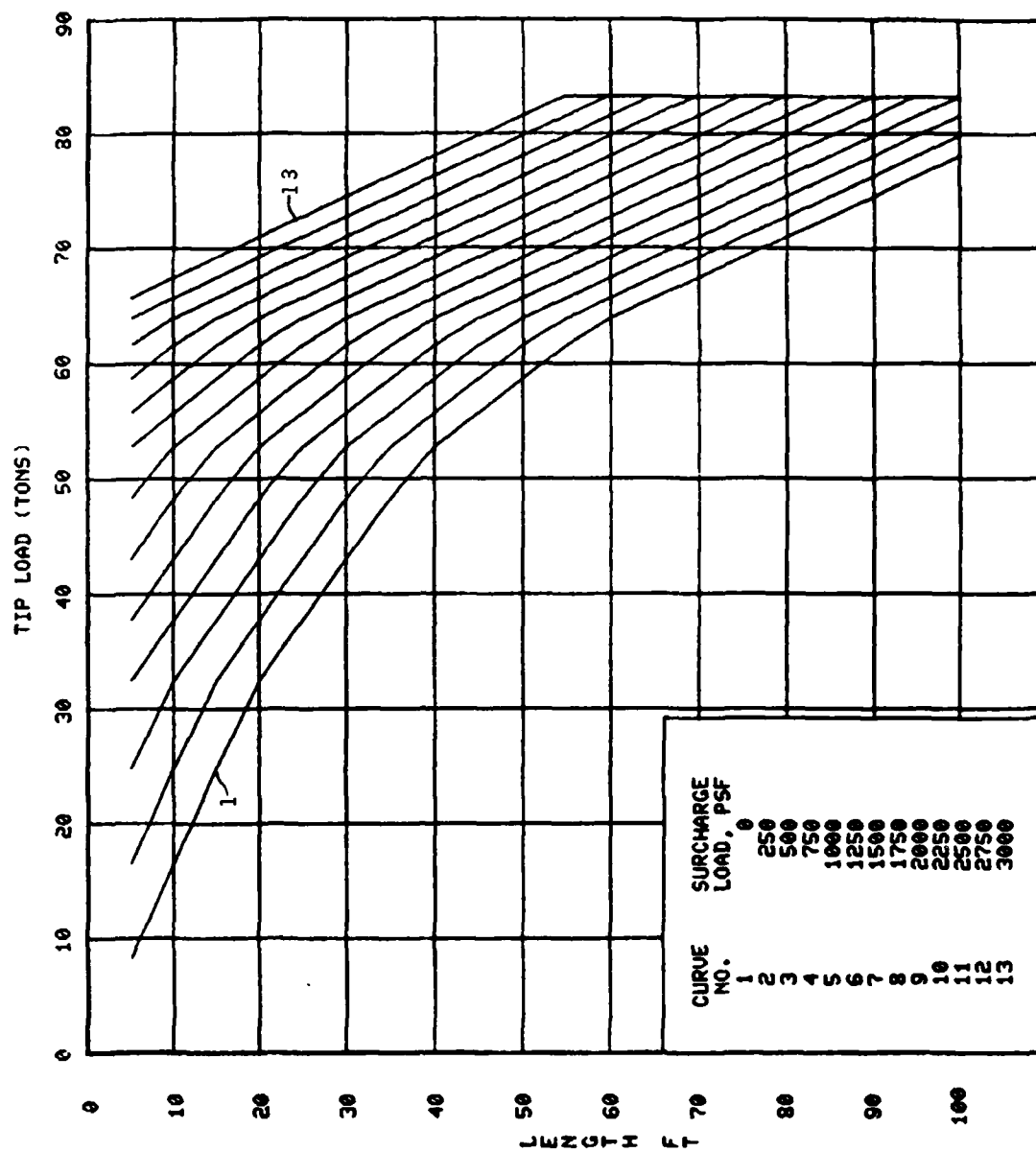


Figure 161. Tip Capacity For A 18-in Square Concrete Pile, Submerged Condition,  $1/4$ -in. Tip Movement,  $\Phi=30$  Deg.,  $C=0$ .



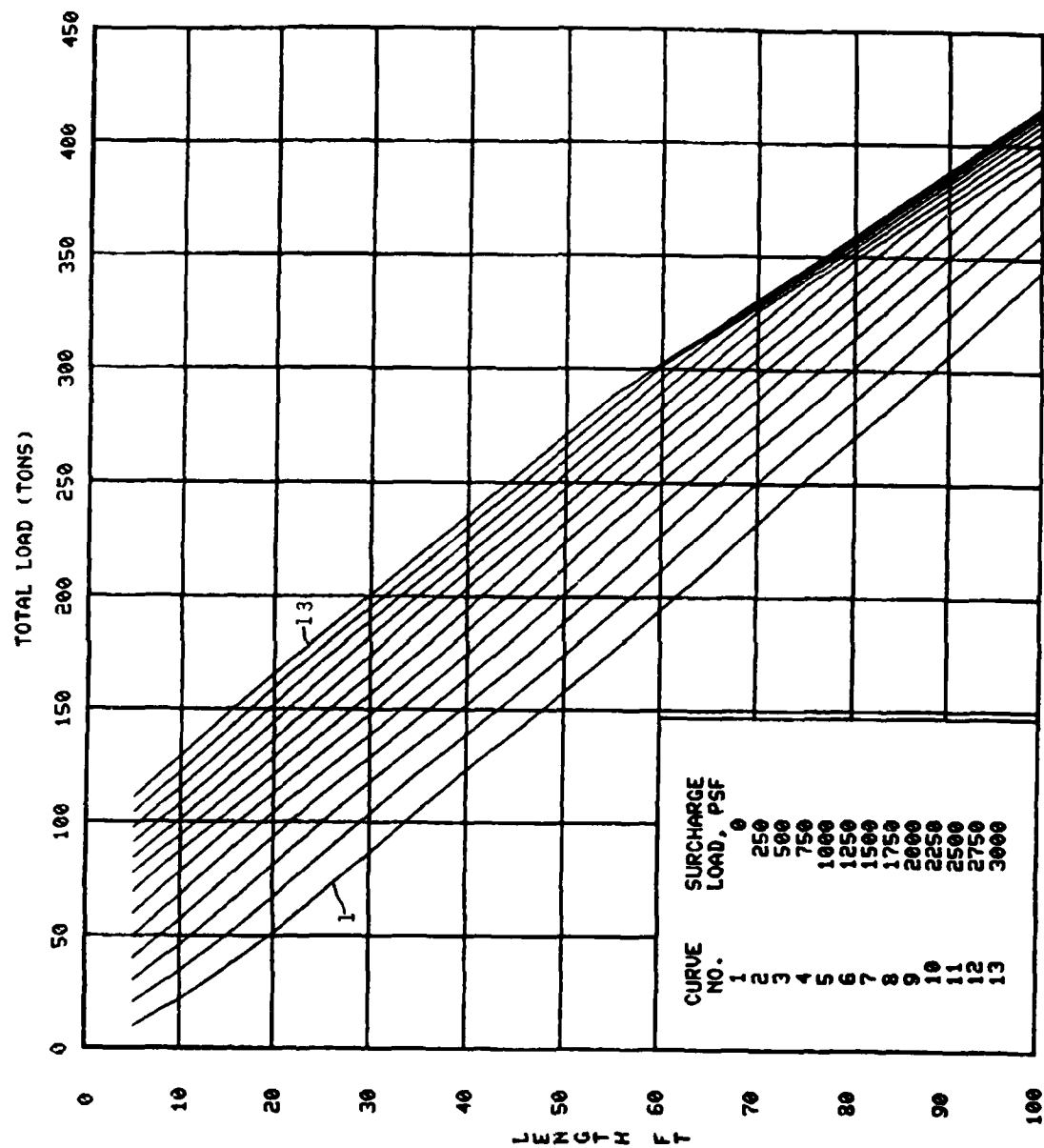


Figure 162. Total Pile Capacity For A 18-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi$ 1-33 Deg., C-0.



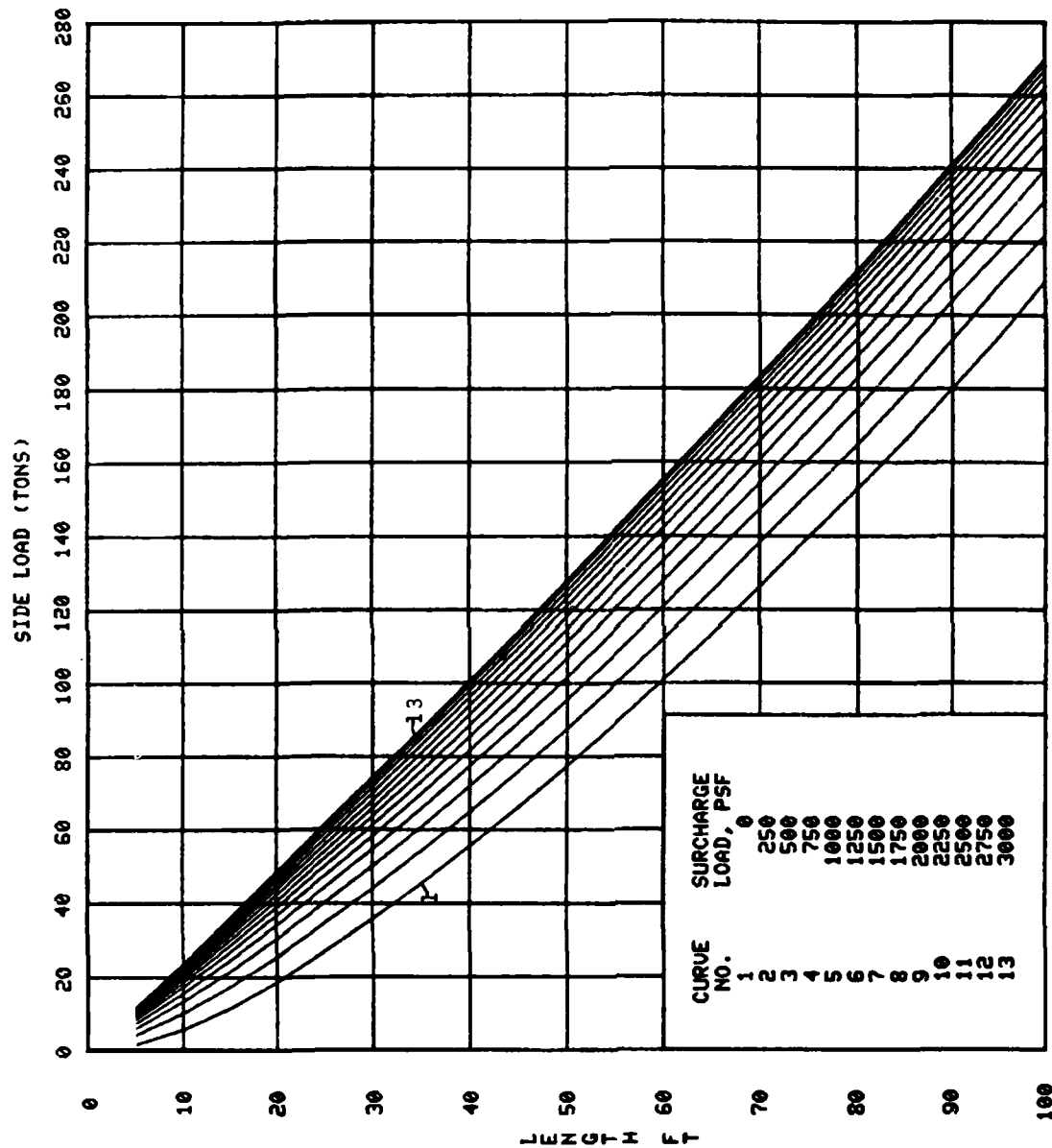


Figure 163. Side Capacity For A 18-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi=33$  Deg.,  $C=0$ .



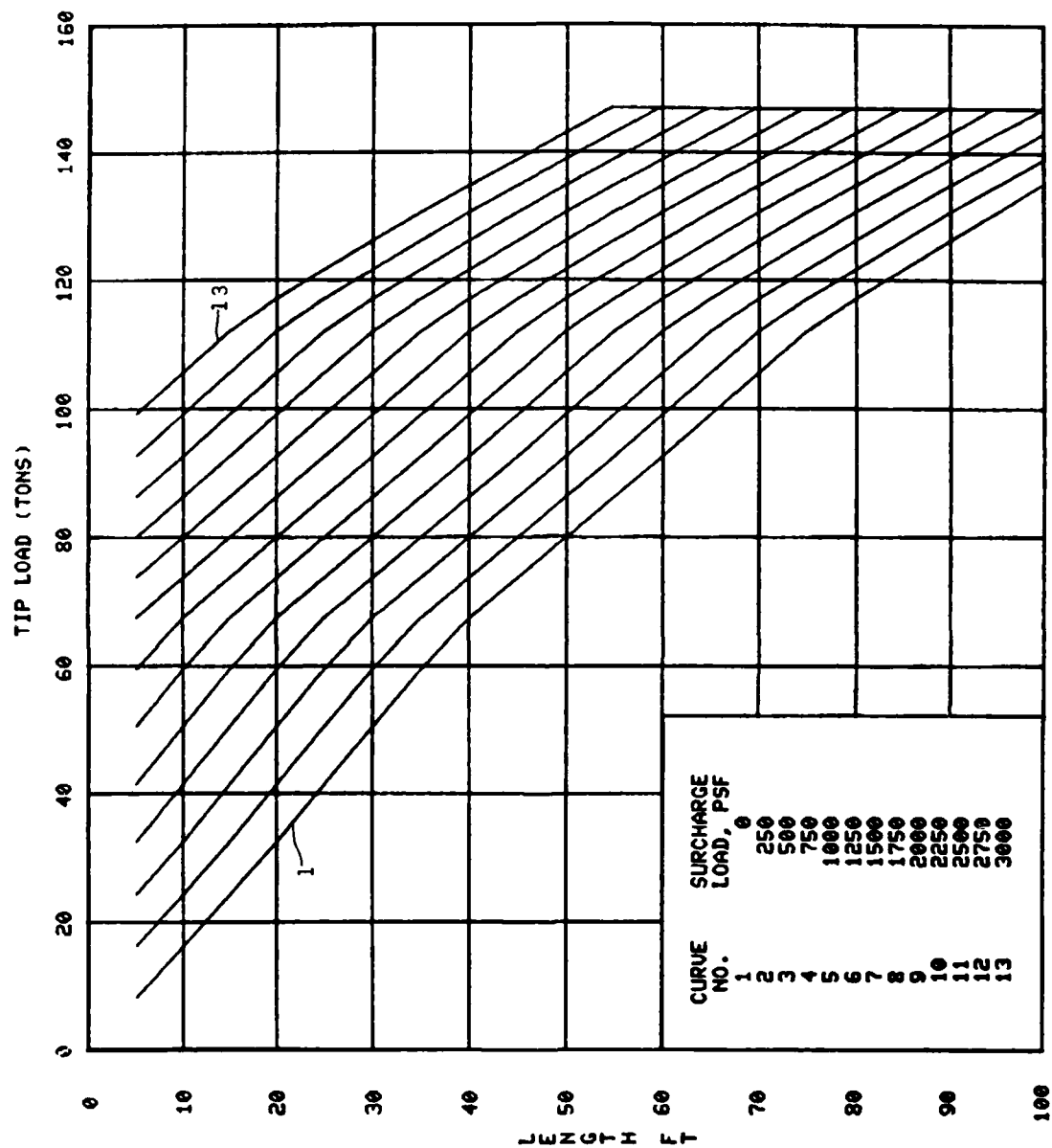


Figure 164. Tip Capacity For A 18-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi$ 1-33 Deg., C-0.



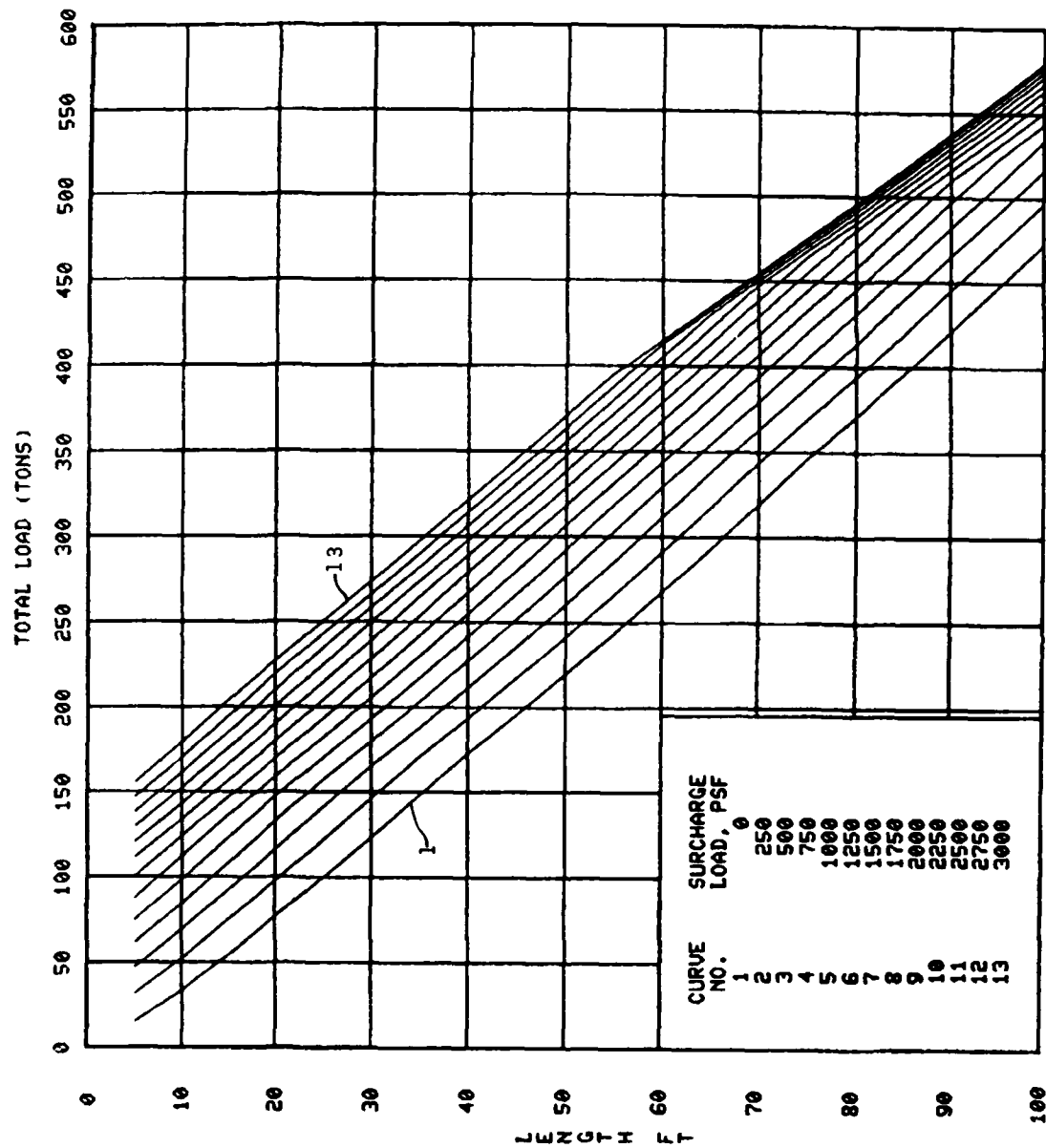


Figure 165. Total Pile Capacity For A 18-in Square Concrete Pile. Submerged Condition, 1/4-in. Tip Movement,  $\Phi=35$  Deg.,  $C=0$ .



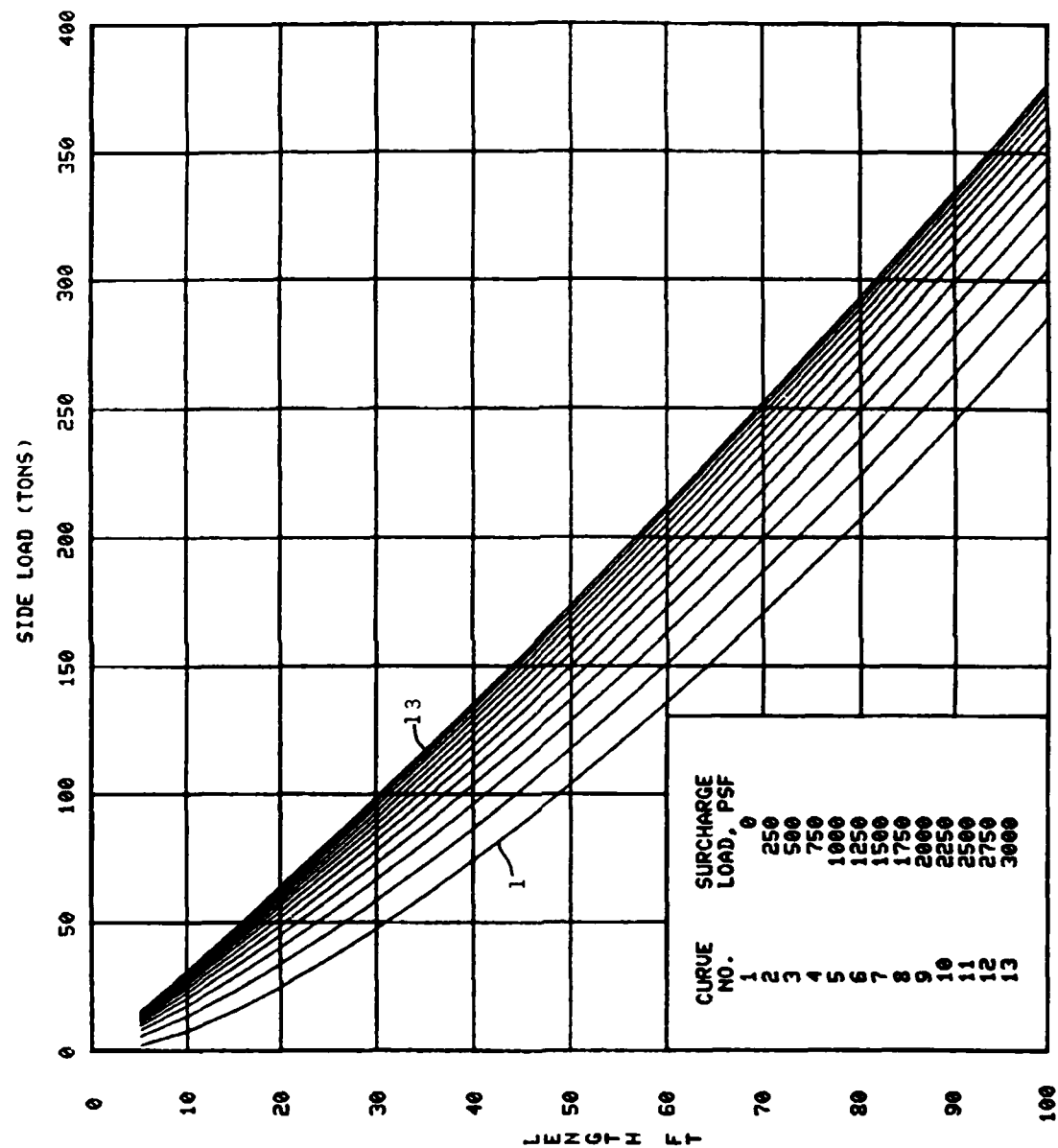


Figure 166. Side Capacity For A 18-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi=35^\circ$ ,  $C=0$ .



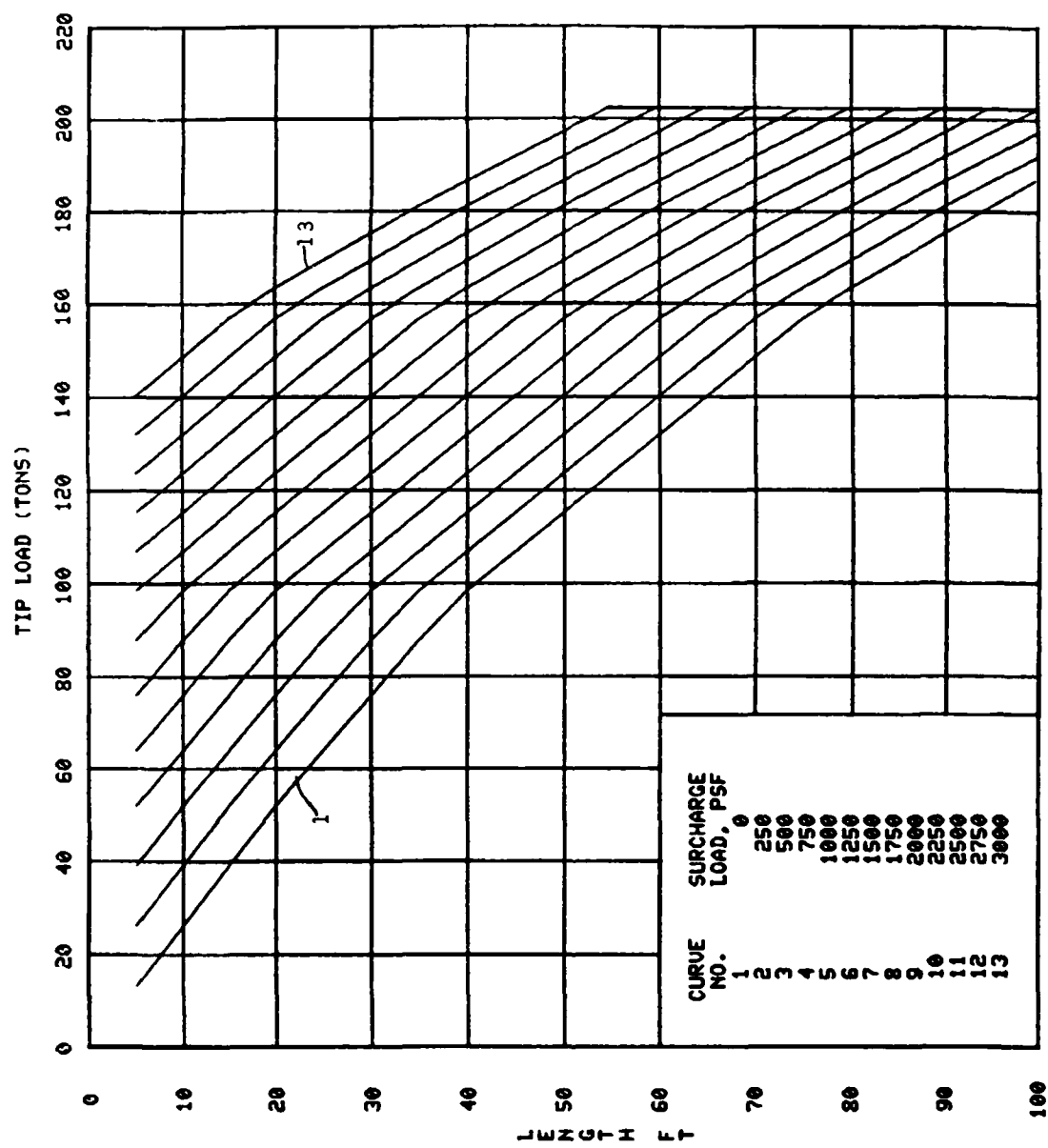


Figure 167. Tip Capacity For A 18-in Square Concrete Pile, Submerged Condition,  $1/4$ -in. Tip Movement,  $\Phi=35$  Deg.,  $C=0$ .



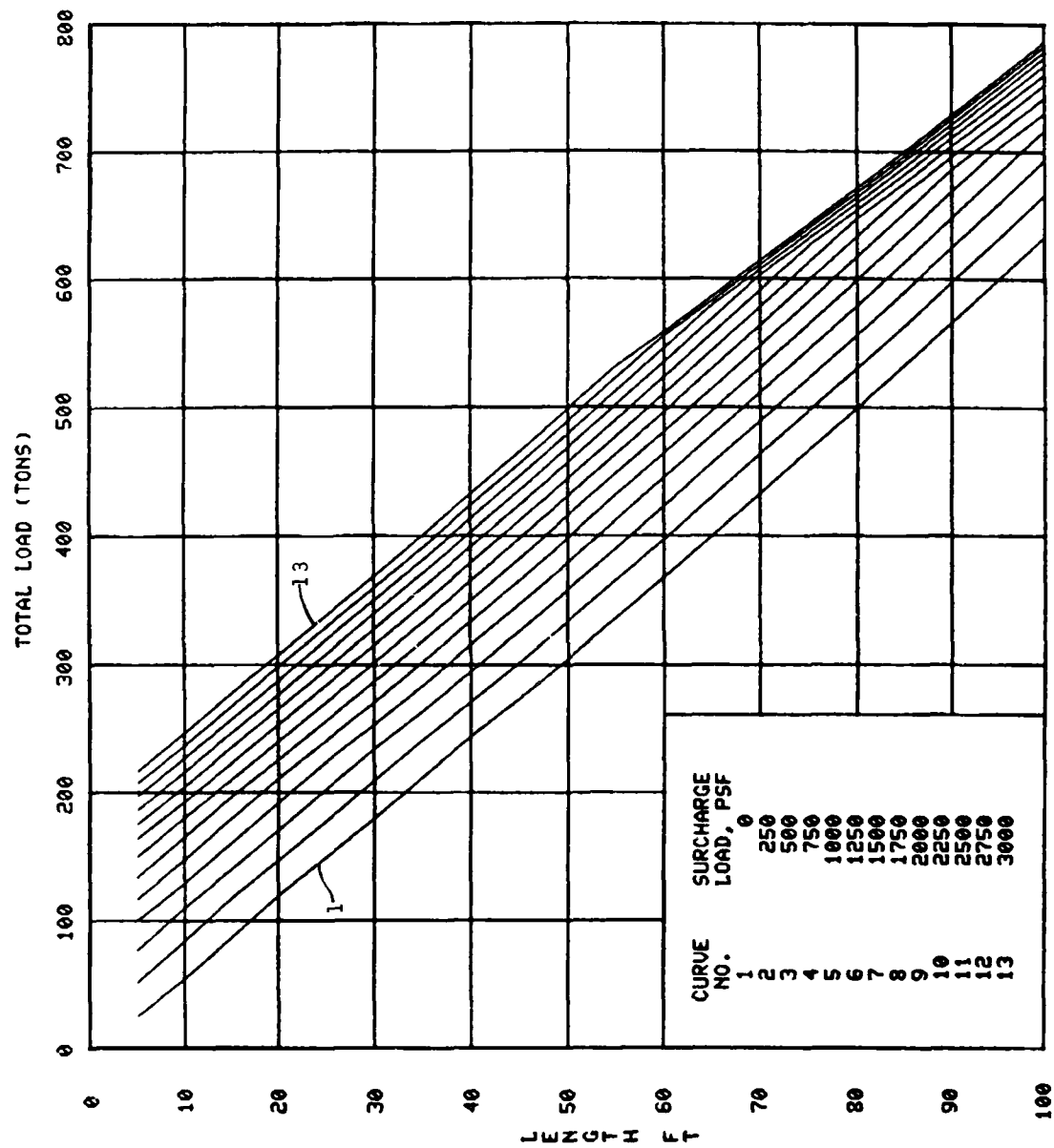


Figure 168. Total Pile Capacity For A 18-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi=37^\circ$ ,  $C=0$ .



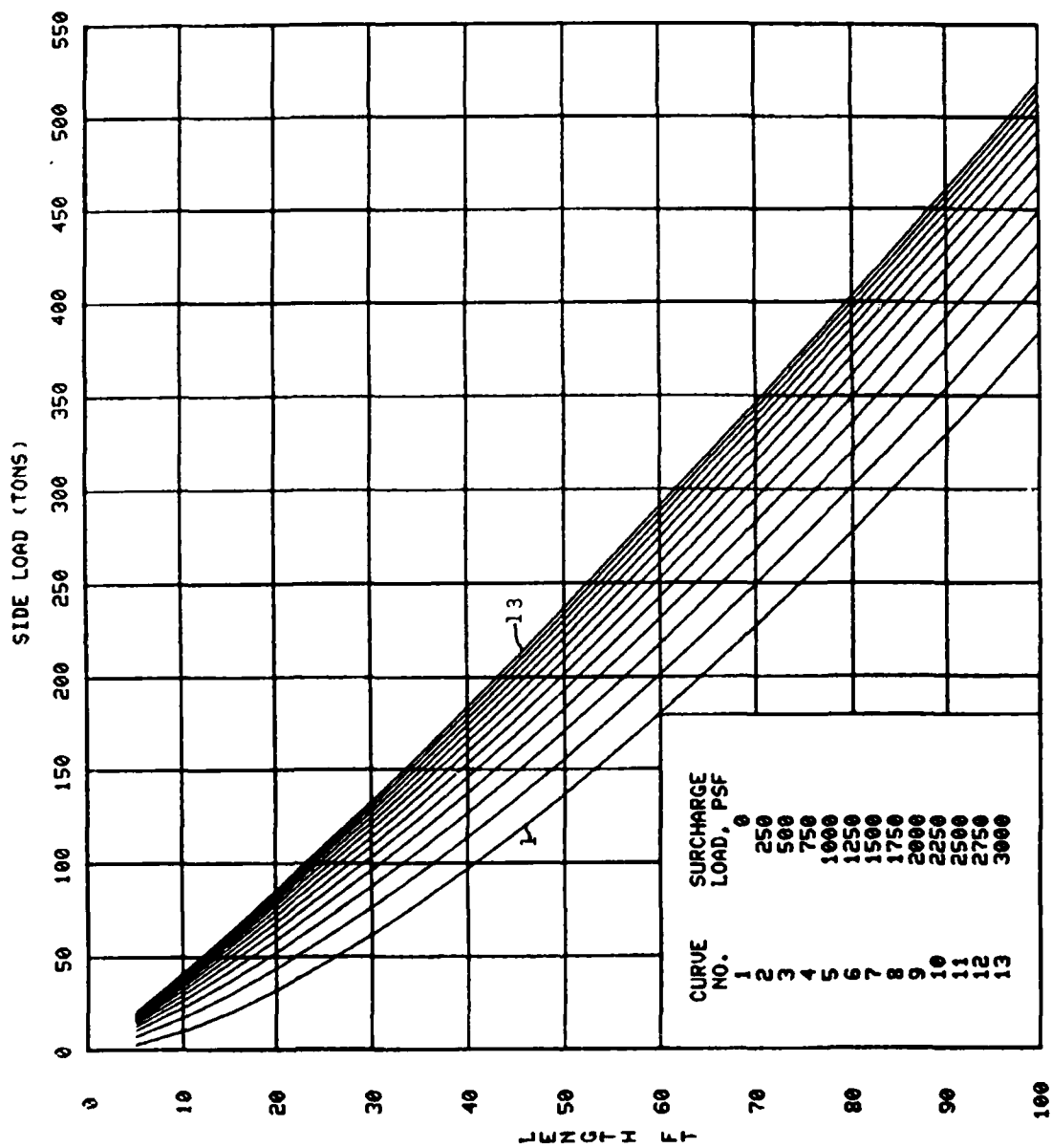


Figure 169. Side Capacity For A 18-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi = 37^\circ$  Deg., C-0.



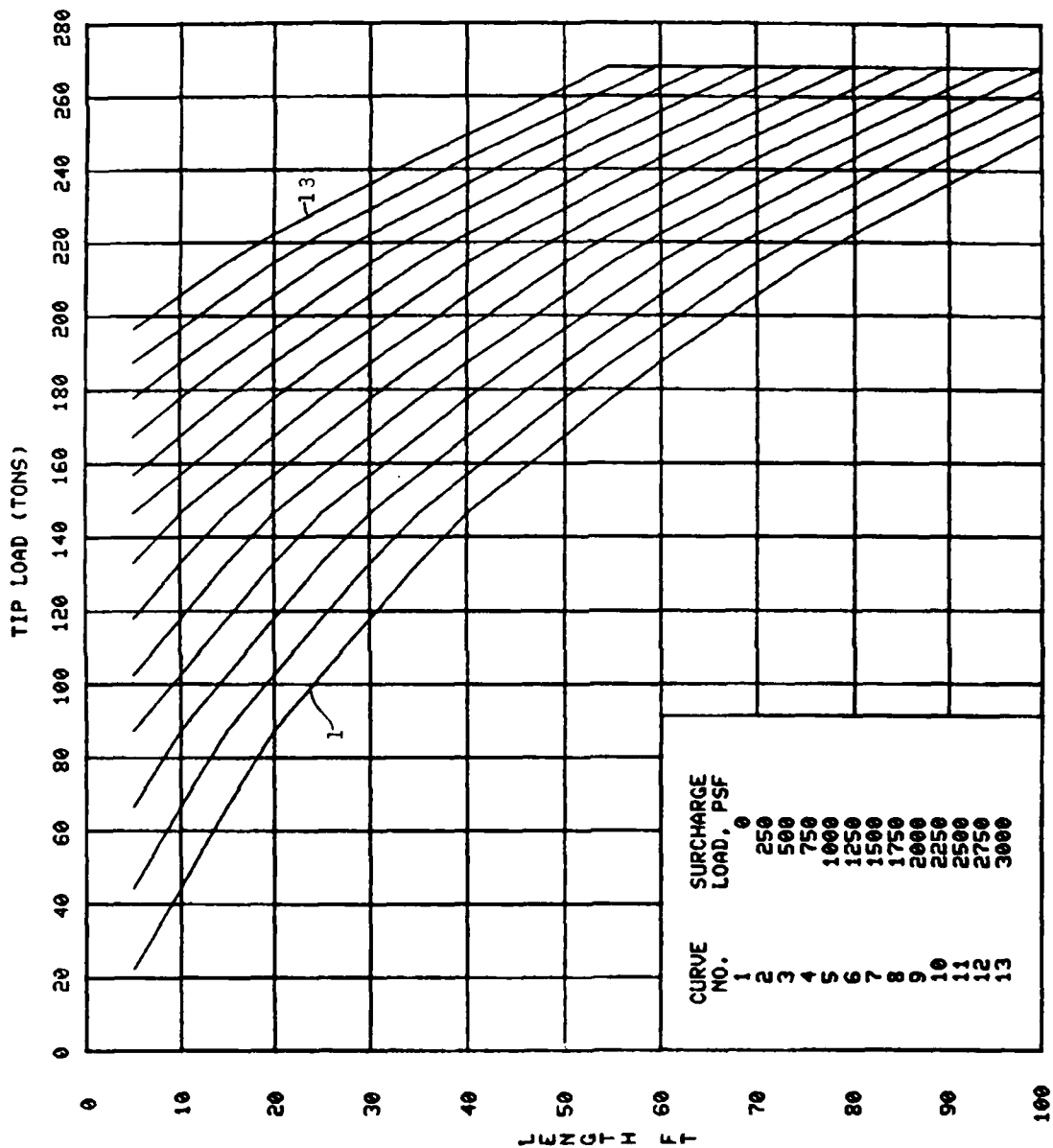


Figure 170. Tip Capacity For A 18-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi=37^\circ$ ,  $C=0$ .



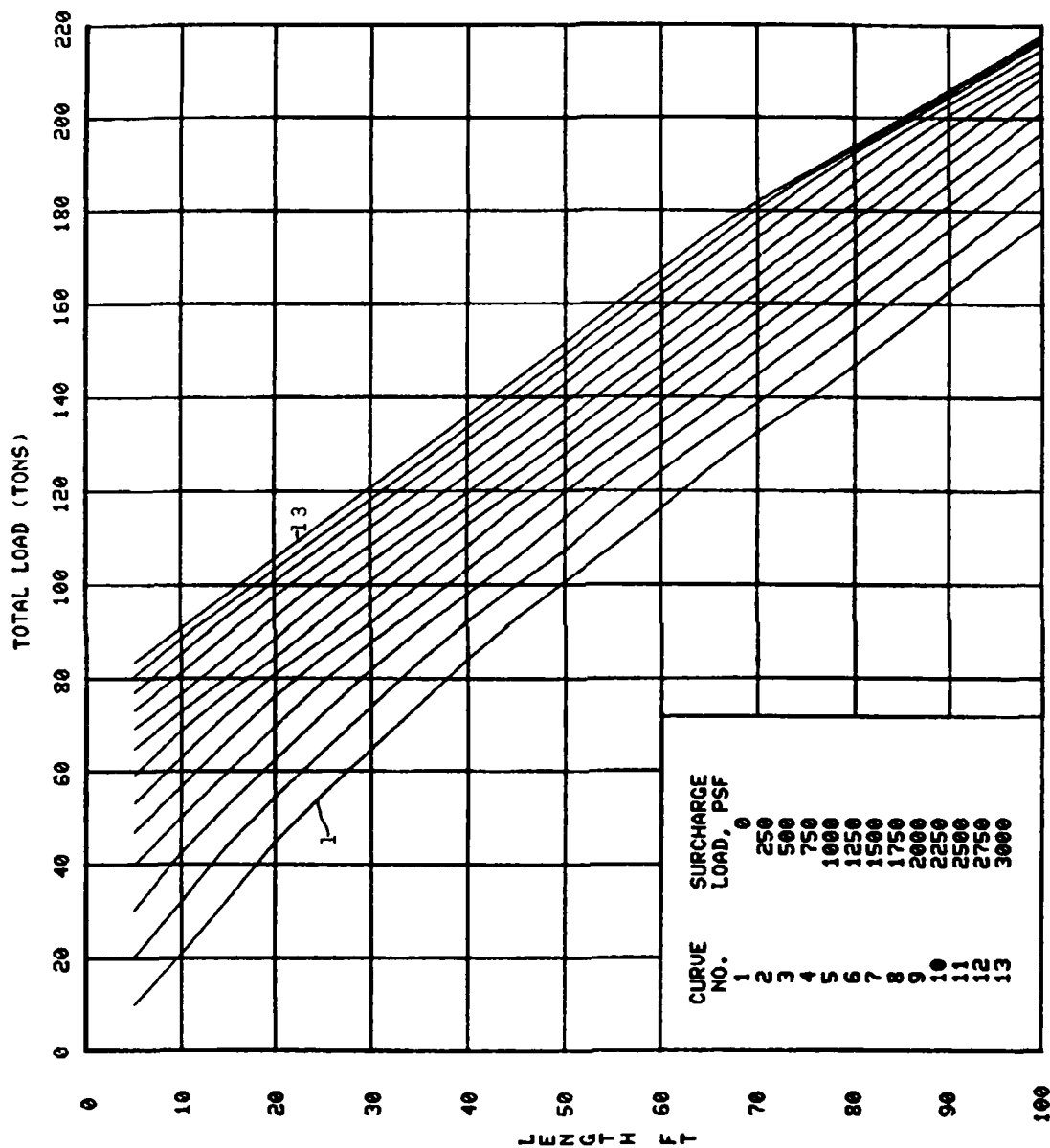


Figure 171. Total Pile Capacity For A 20-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi=30^\circ$  Deg., C-0.



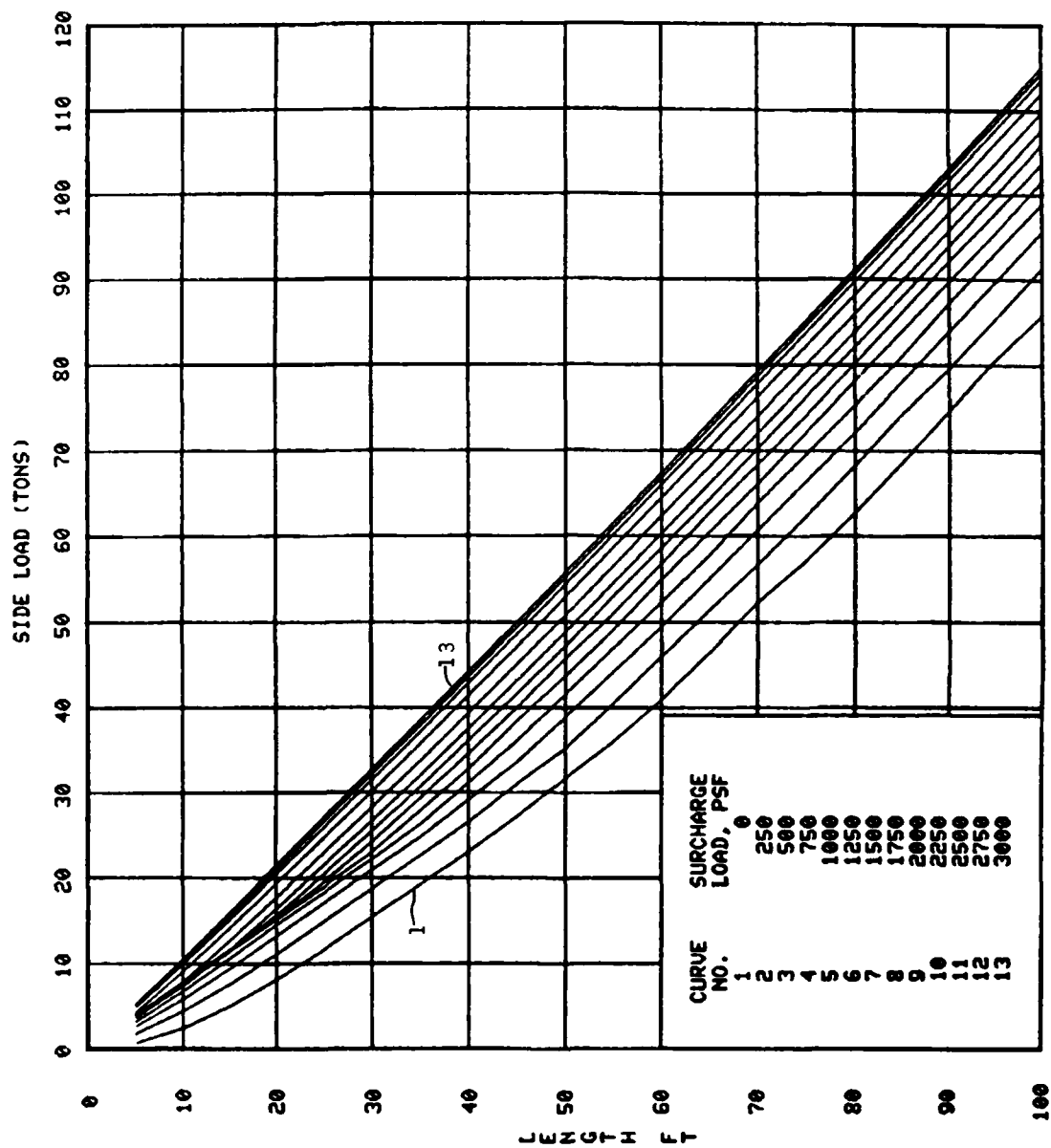


Figure 172. Side Capacity For A 20-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi=30$  Deg.,  $C=0$ .



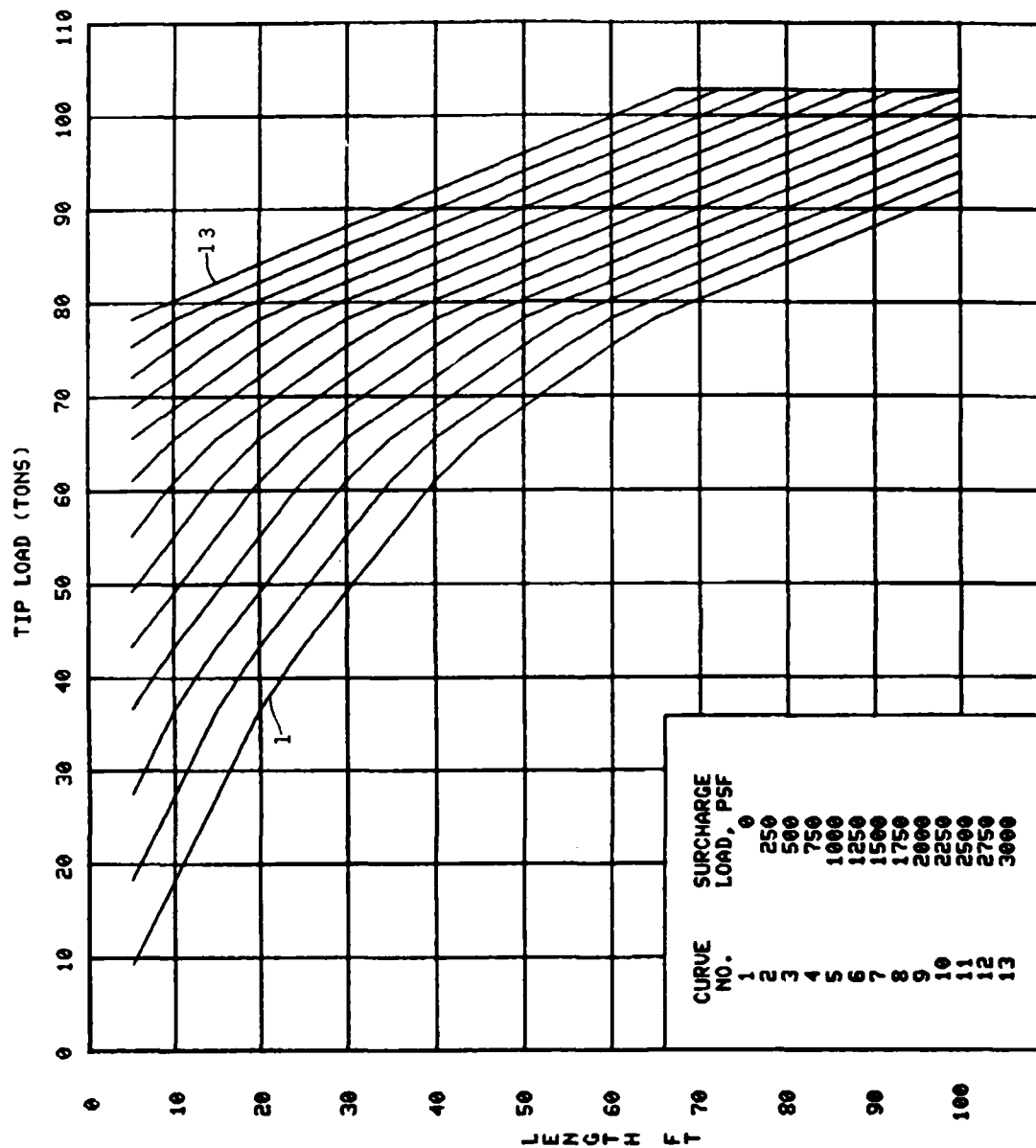


Figure 173. Tip Capacity For A 20-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi=30$  Deg., C-0.



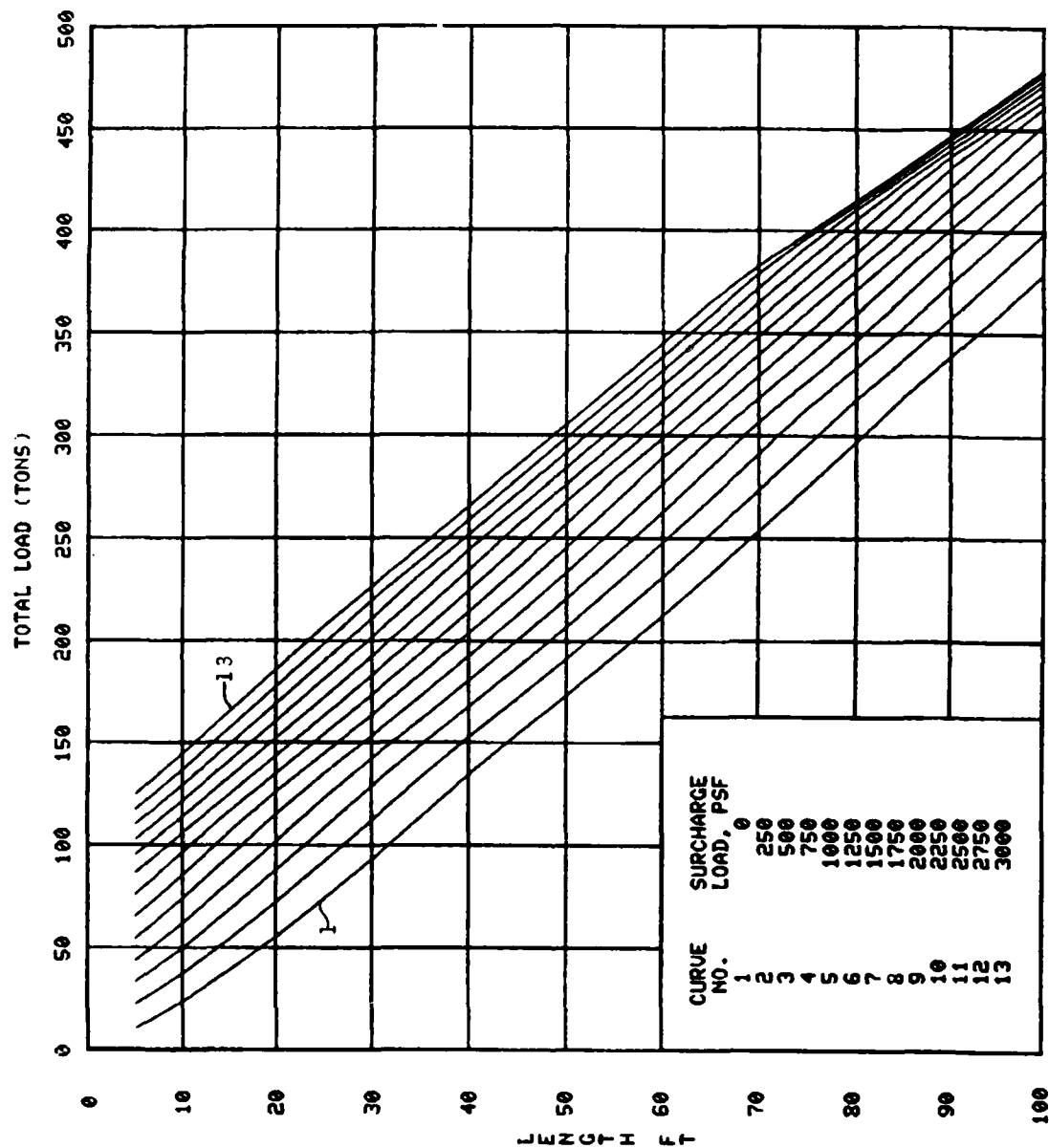


Figure 174. Total Pile Capacity For A 20-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi$ 1-33 Deg., C-0.



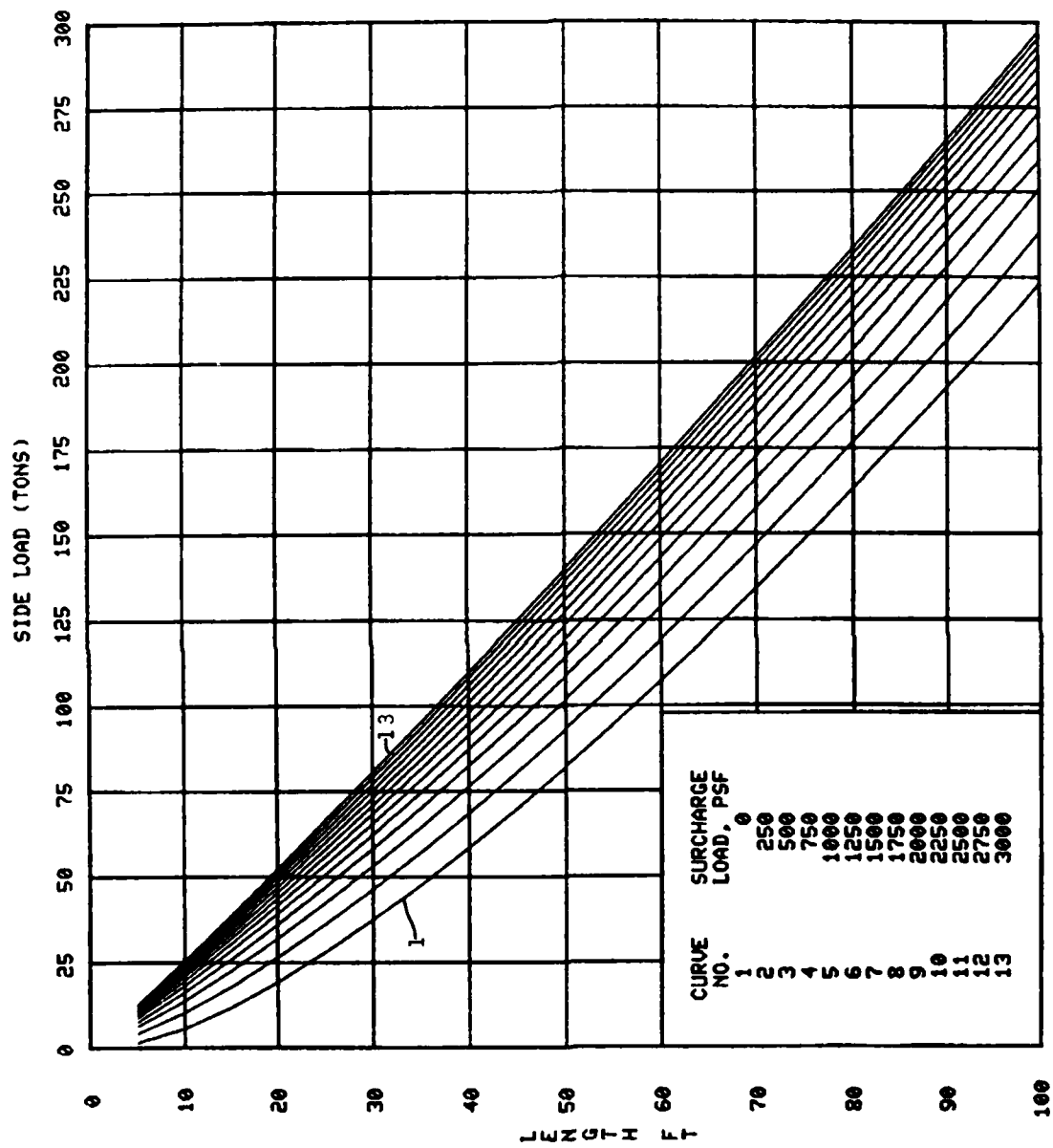


Figure 175. Side Capacity For A 20-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi=33^\circ$  Deg., C-0.



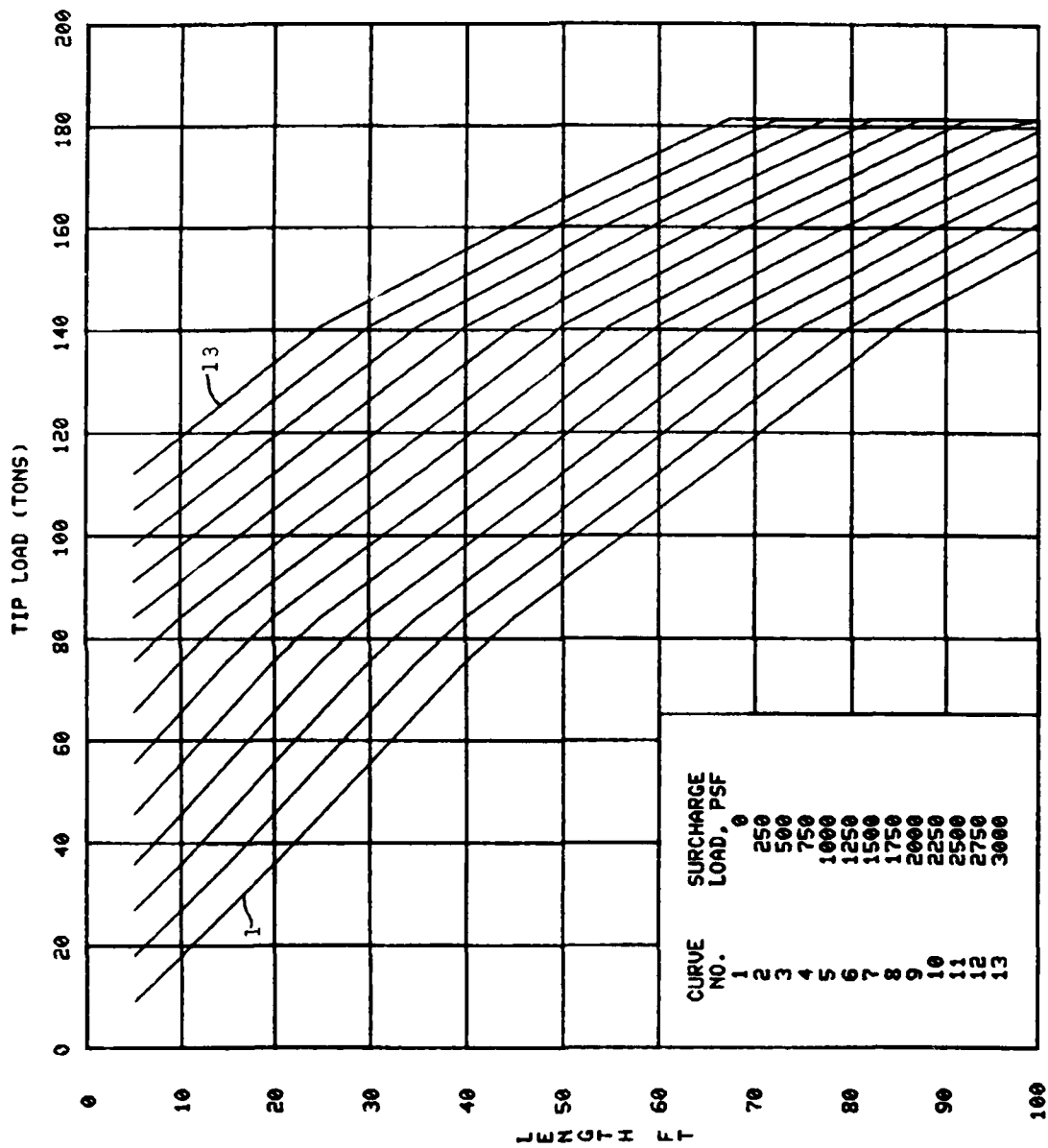


Figure 176. Tip Capacity For A 20-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi$ -33 Deg., C-0.



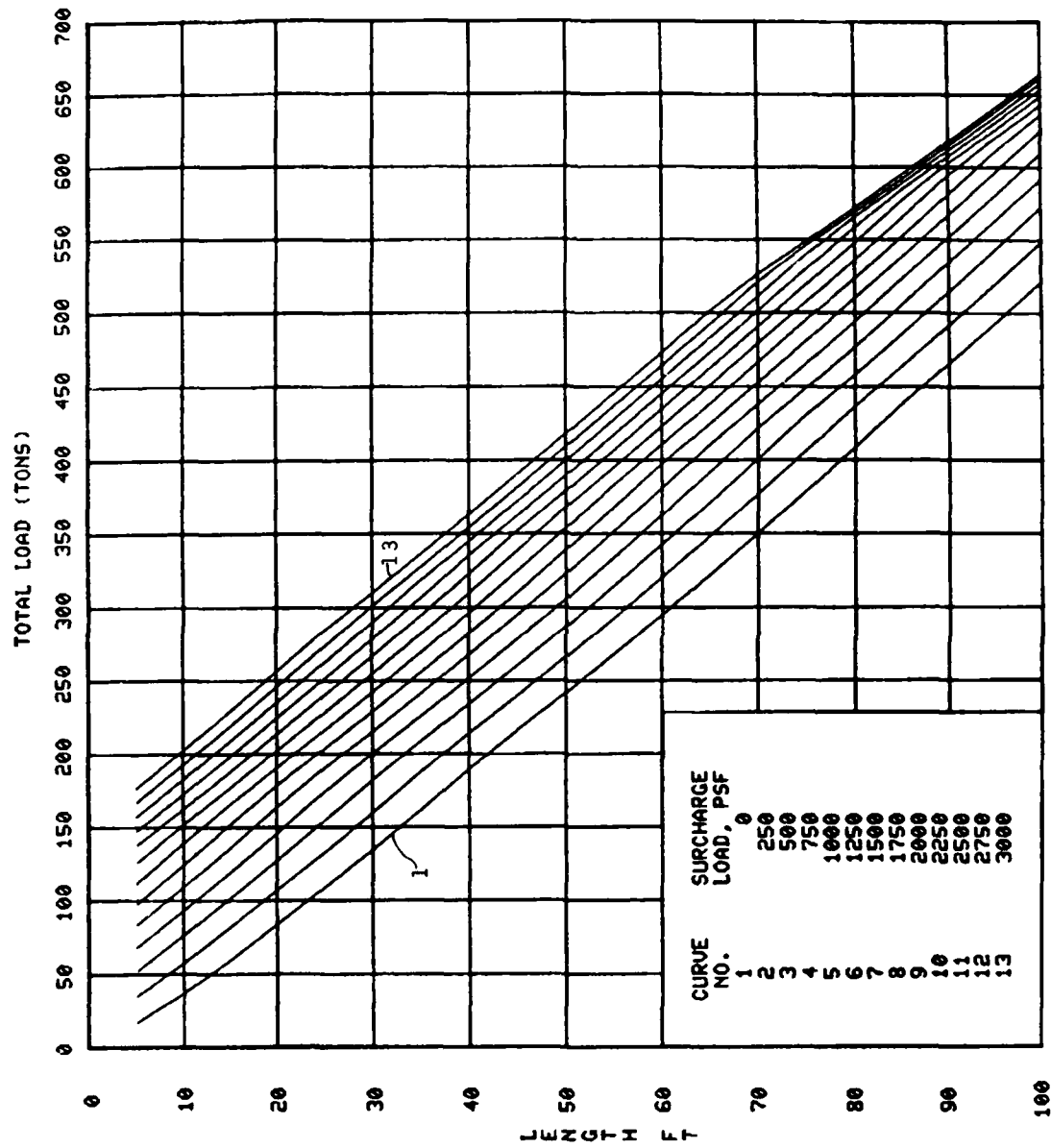


Figure 177. Total Pile Capacity For A 20-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi$ -35 Deg., C-0.



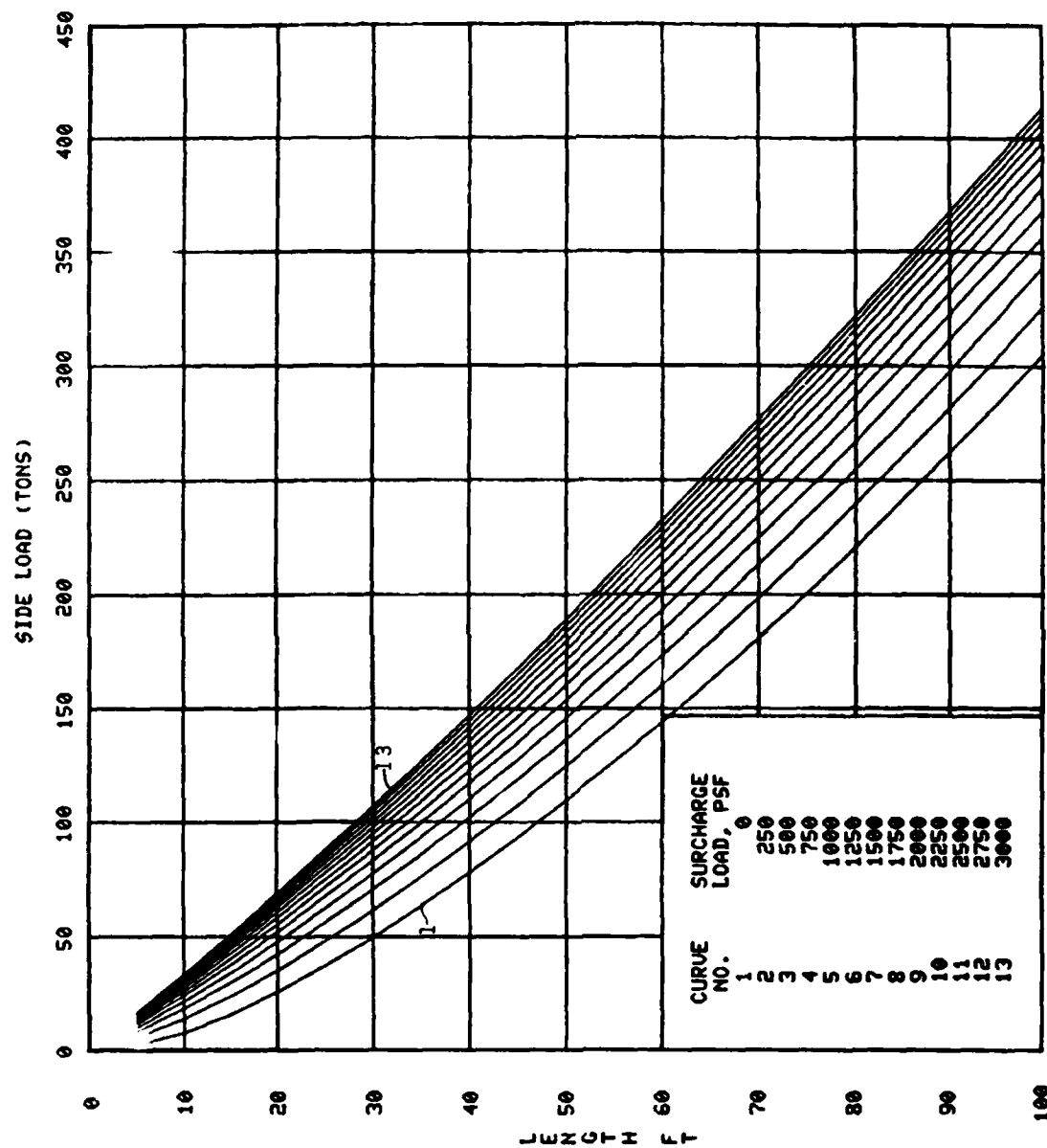


Figure 178. Side Capacity For A 20-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi=35^\circ$ ,  $C=0$ .



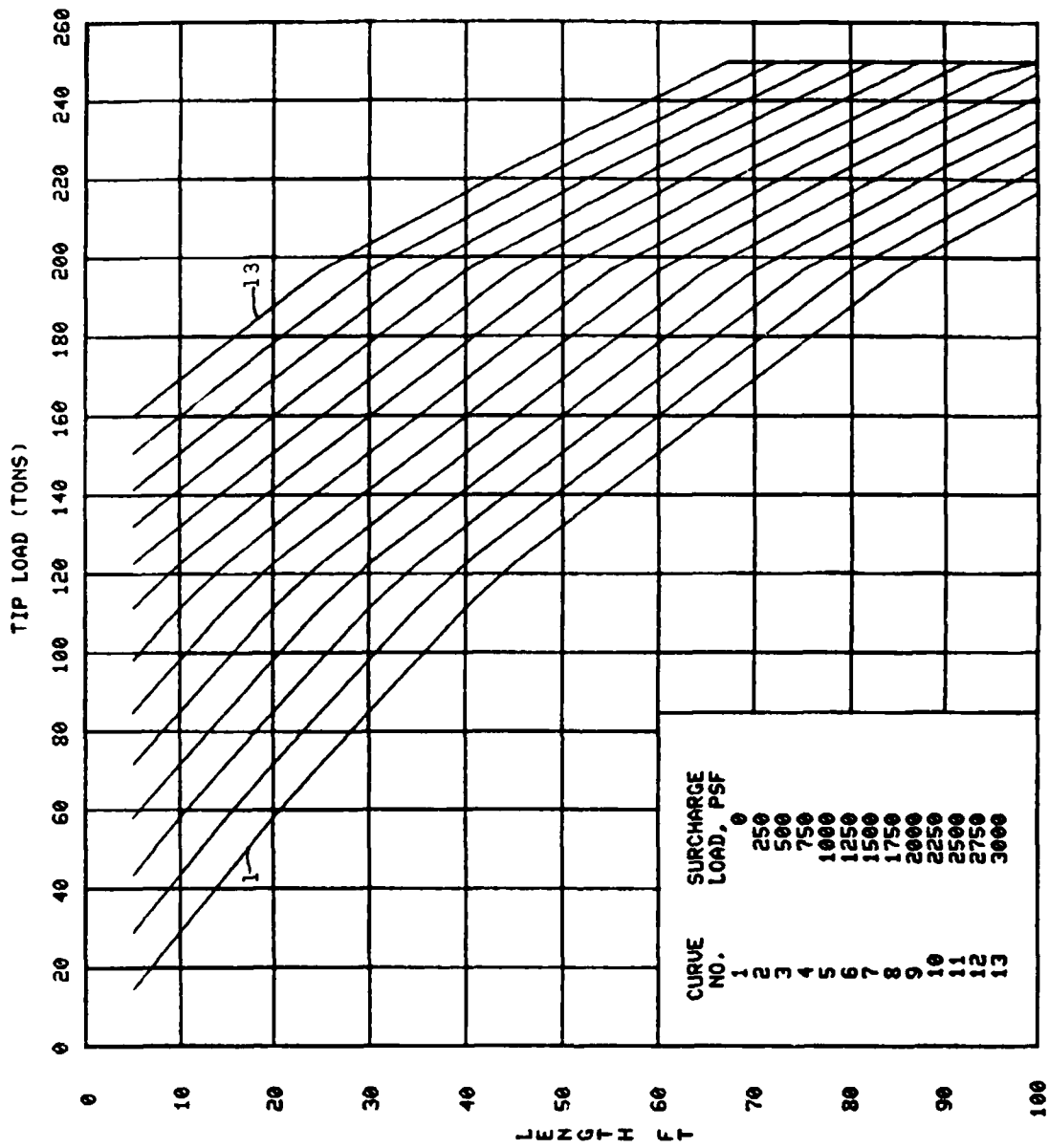


Figure 179. Tip Capacity For A 20-in Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi$ 1-35 Deg., C-0.



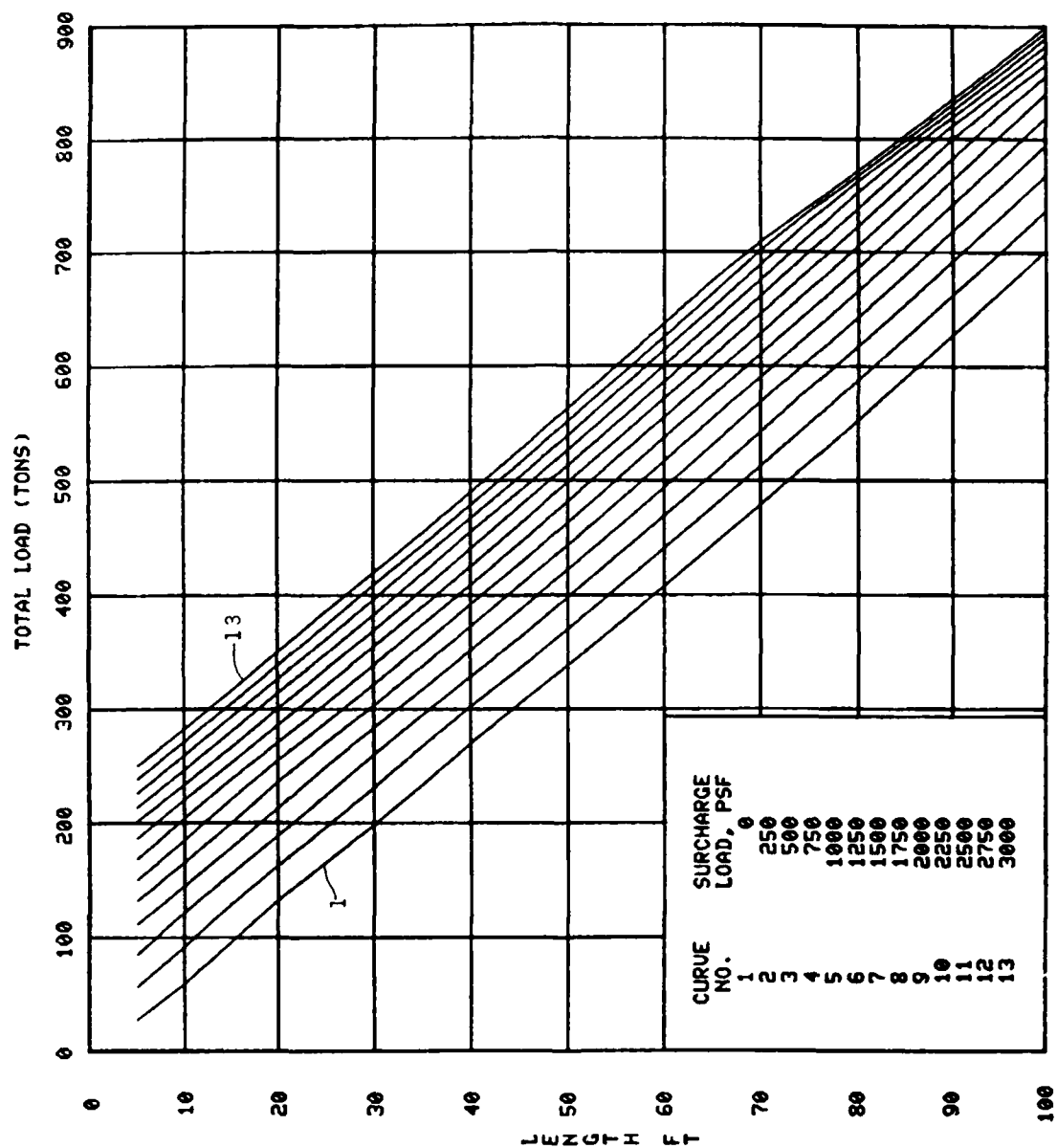


Figure 180. Total Pile Capacity For A 20-in. Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi=37^\circ$ ,  $C=0$



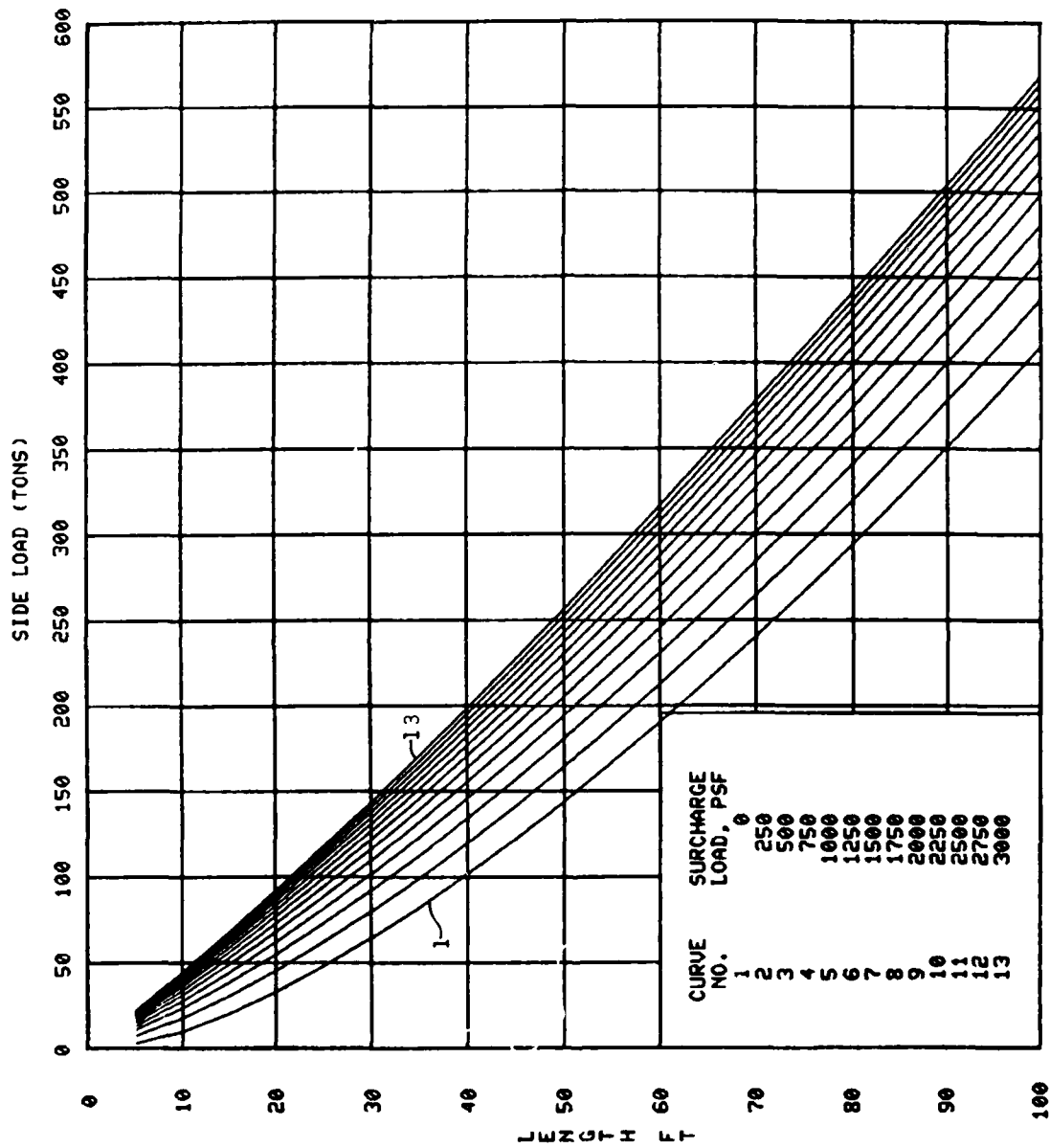


Figure 181. Side Capacity For A 20-in. Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi=37$  Deg.,  $C=0$



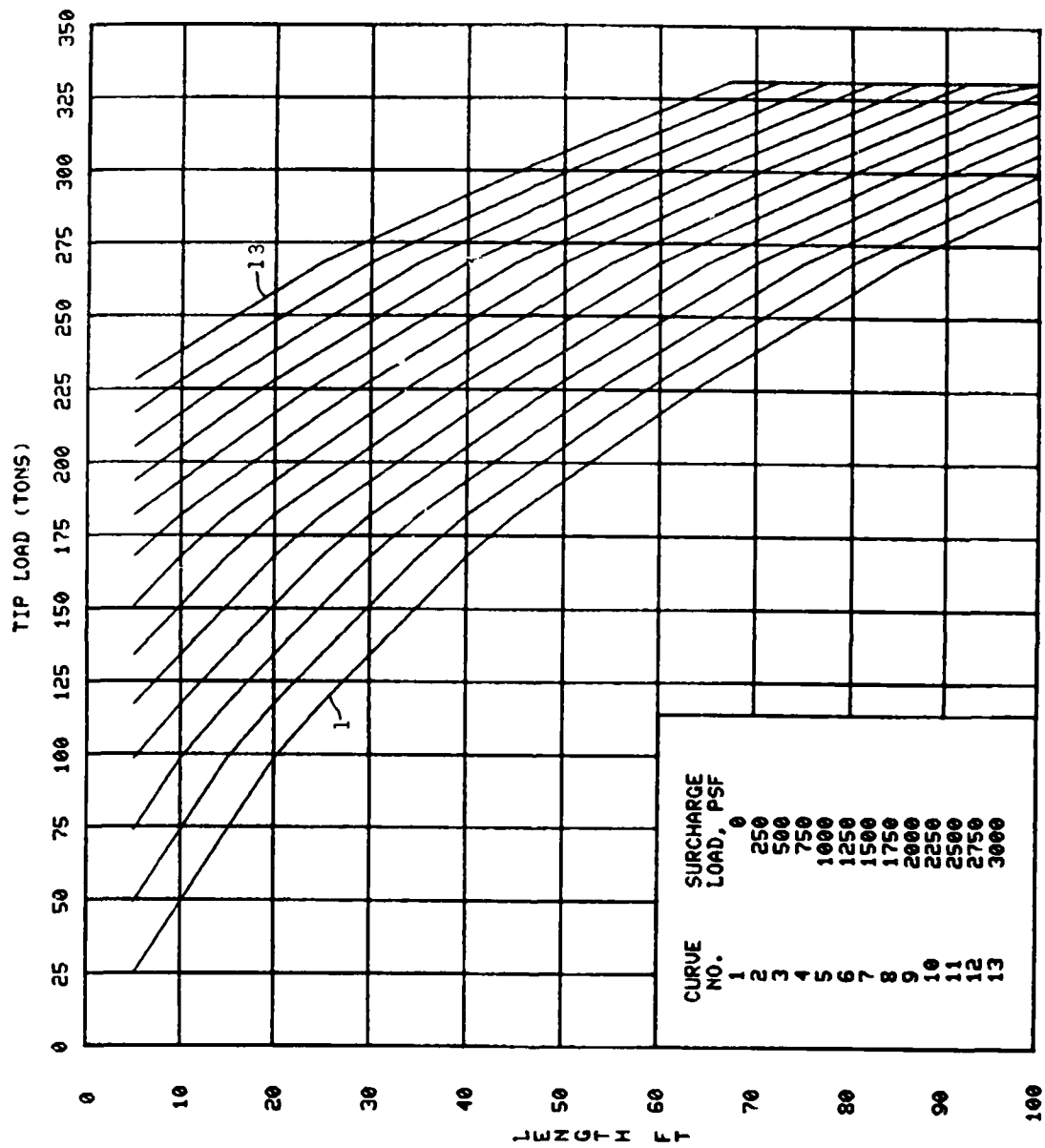


Figure 182. Tip Capacity For A 20-in. Square Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi=37$  Deg., C-0



## CHAPTER 5: LOAD CAPACITY CURVES FOR ROUND CONCRETE PILES

Total pile, side, and pit capacity curves for round concrete piles are presented as follows:

<u>Curves for</u>	<u>Shown in Figure</u>
10 Inches	183-194
12 Inches	195-206
14 Inches	207-218
16 Inches	219-230



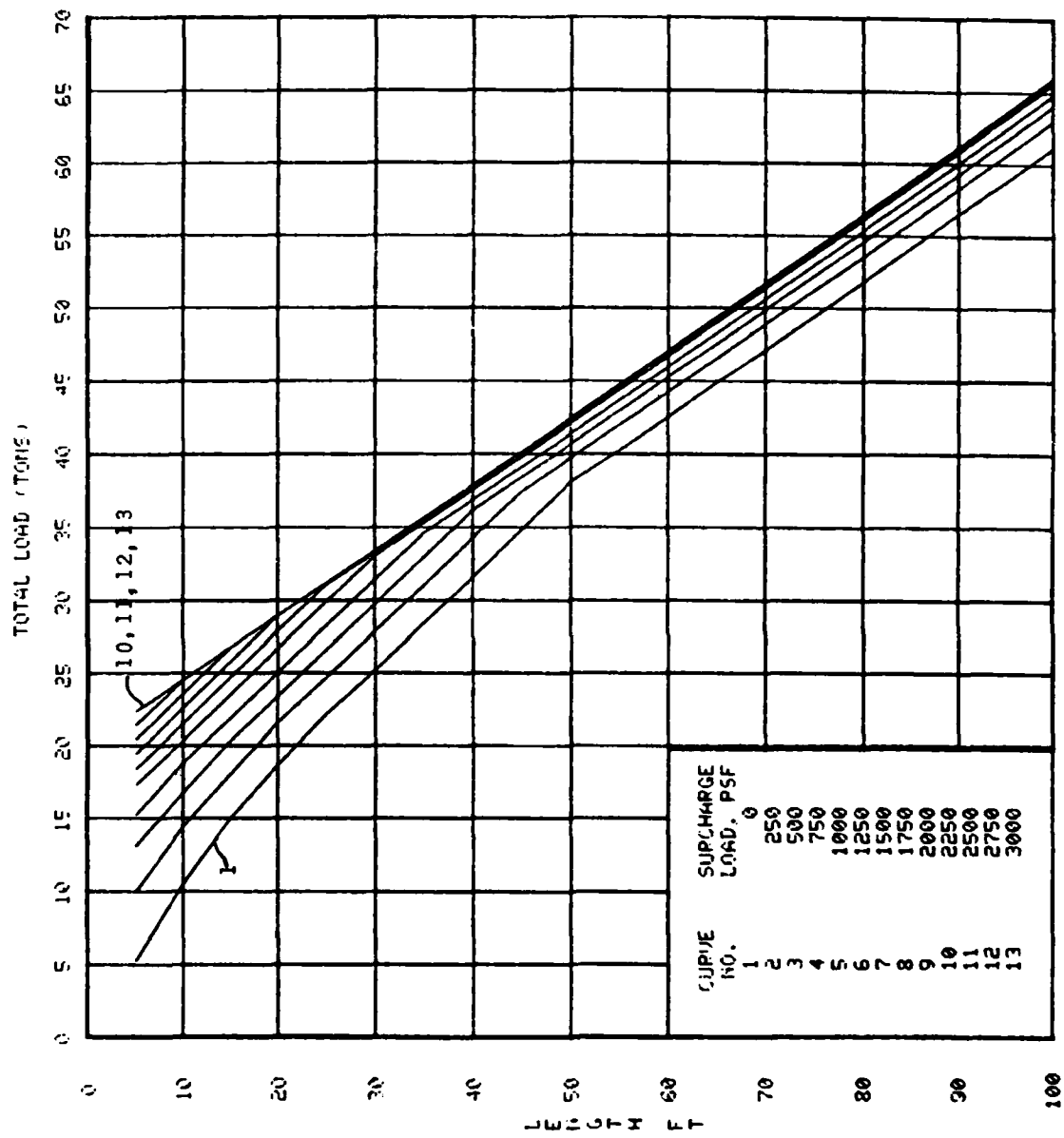


Figure 183. Total Pile Capacity For A 10-in Round Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi=30$  Deg.,  $C=0$ .



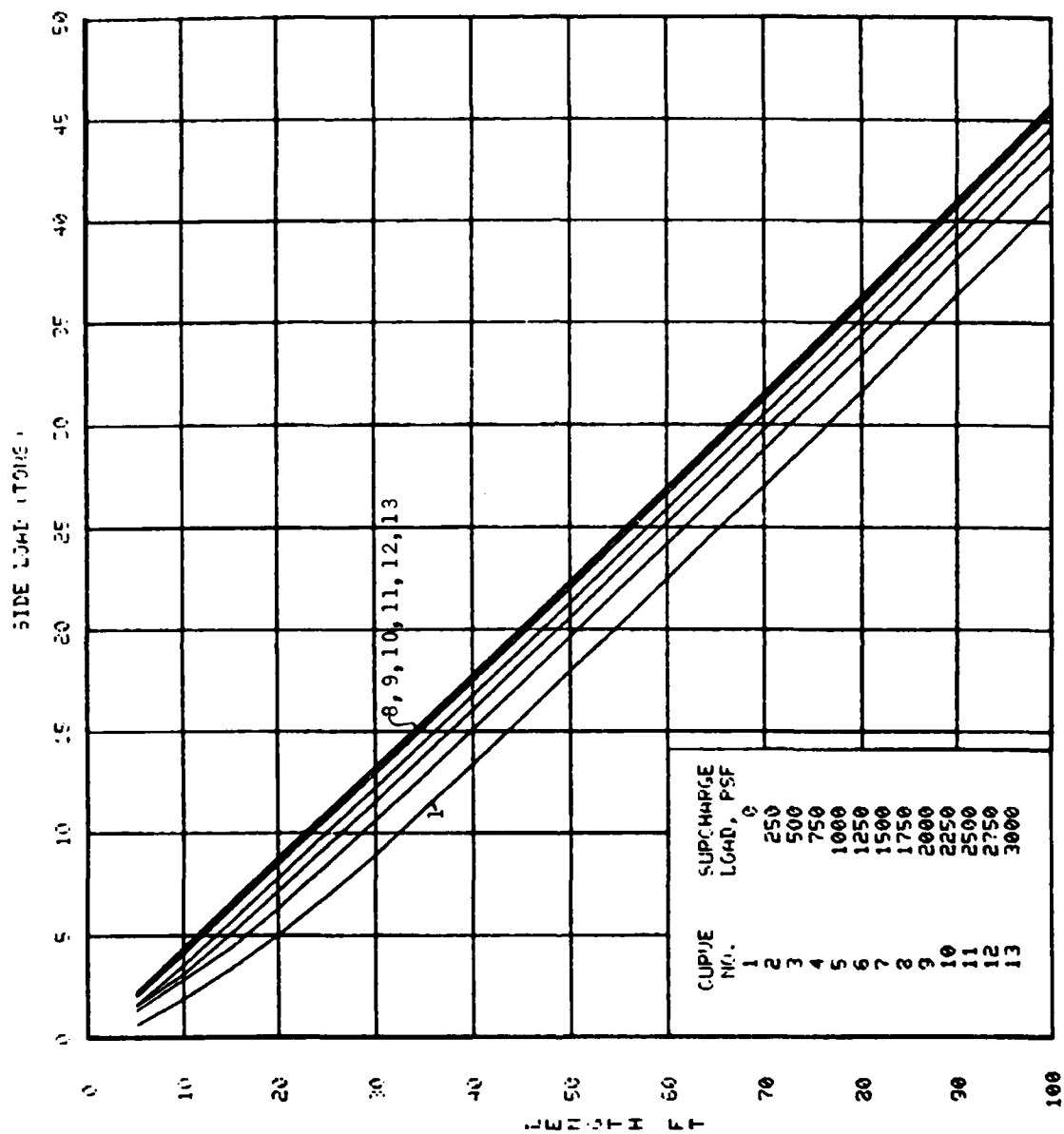


Figure 184. Side Capacity For A 10-in Round Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi=30$  Deg.,  $C=0$ .



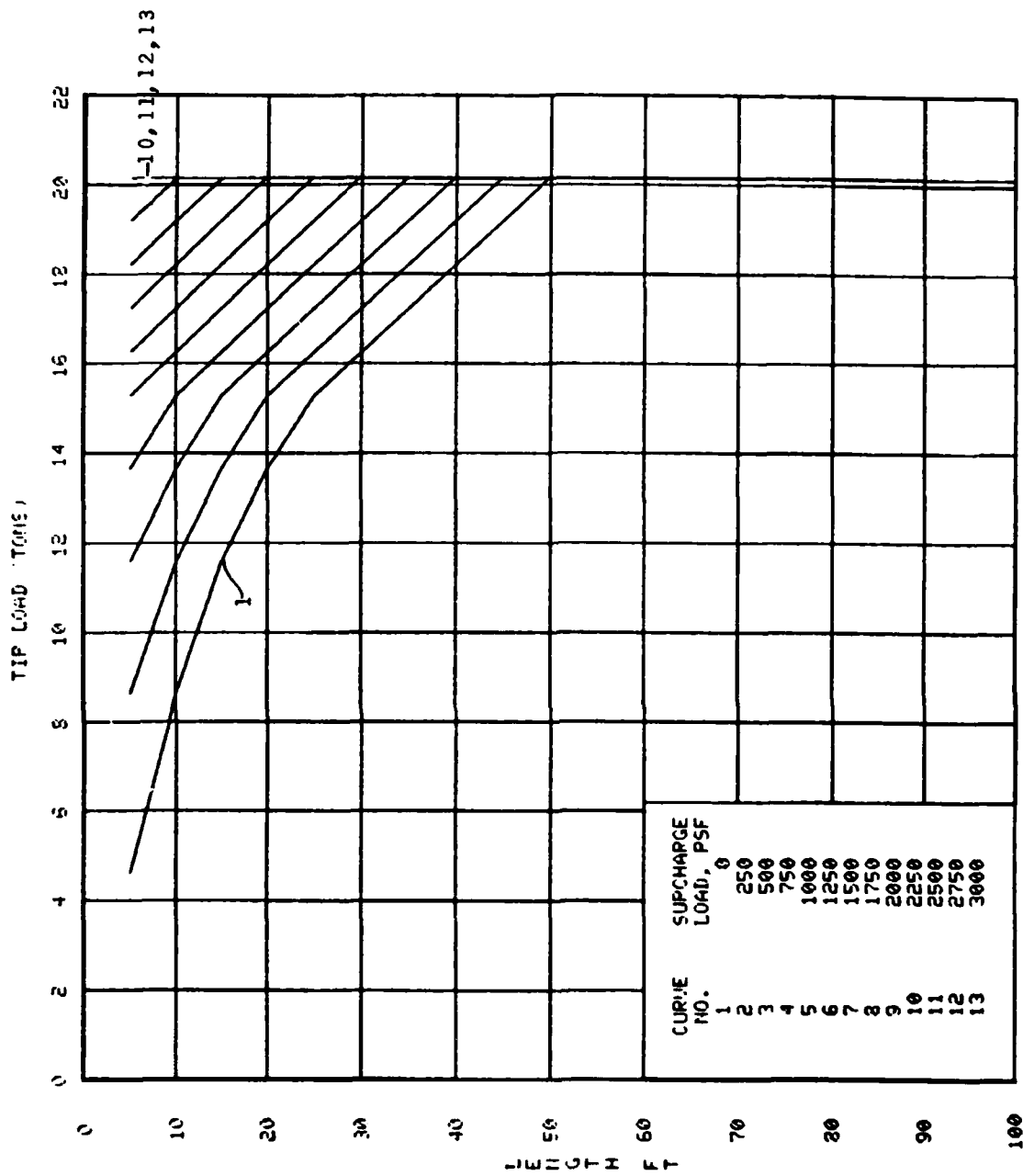


Figure 185. Tip Capacity For A 10-in Round Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi=30$  Deg.,  $C=0$ .



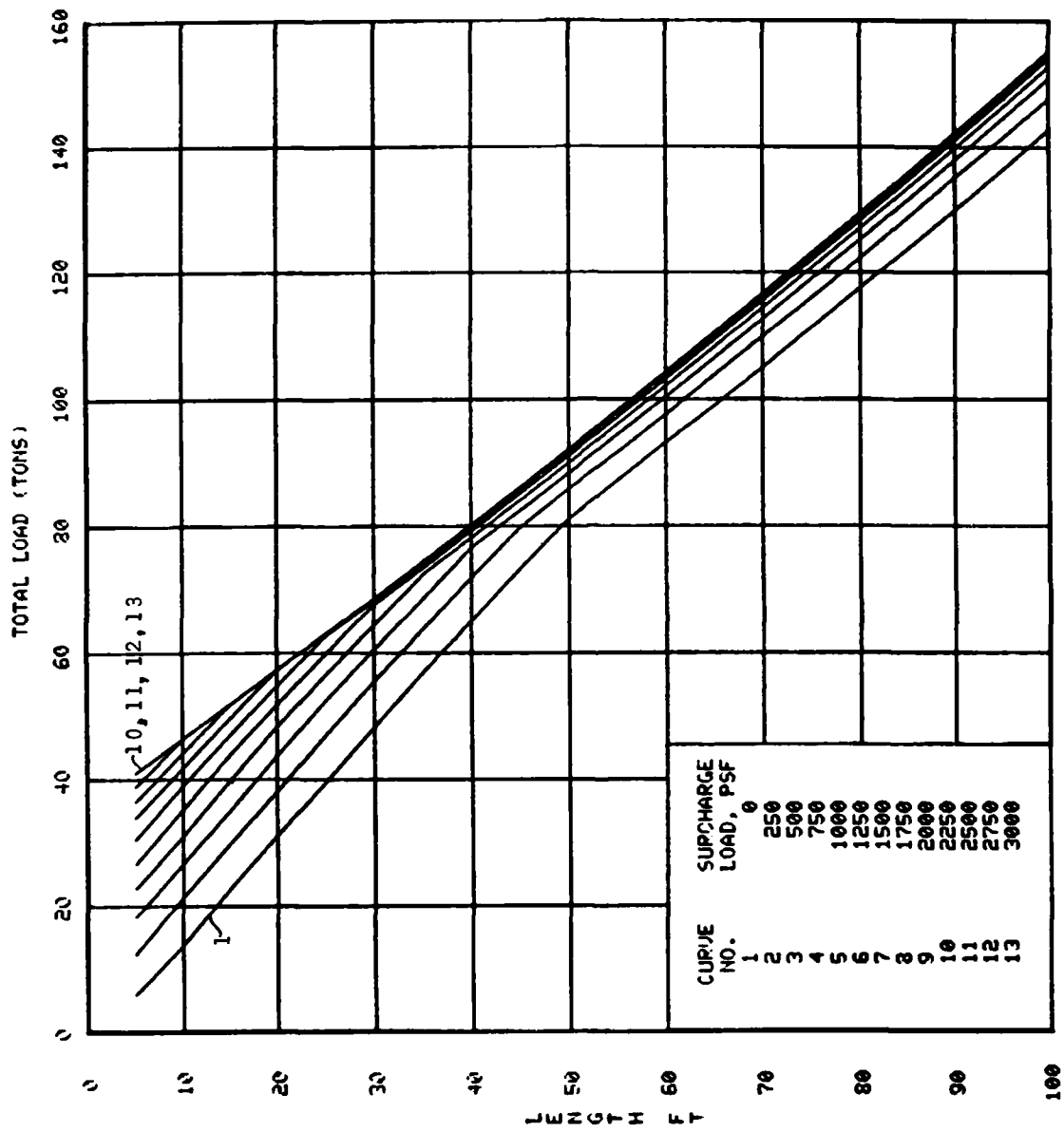


Figure 186. Total Pile Capacity For A 10-in Round Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi=33$  Deg.,  $C=0$ .



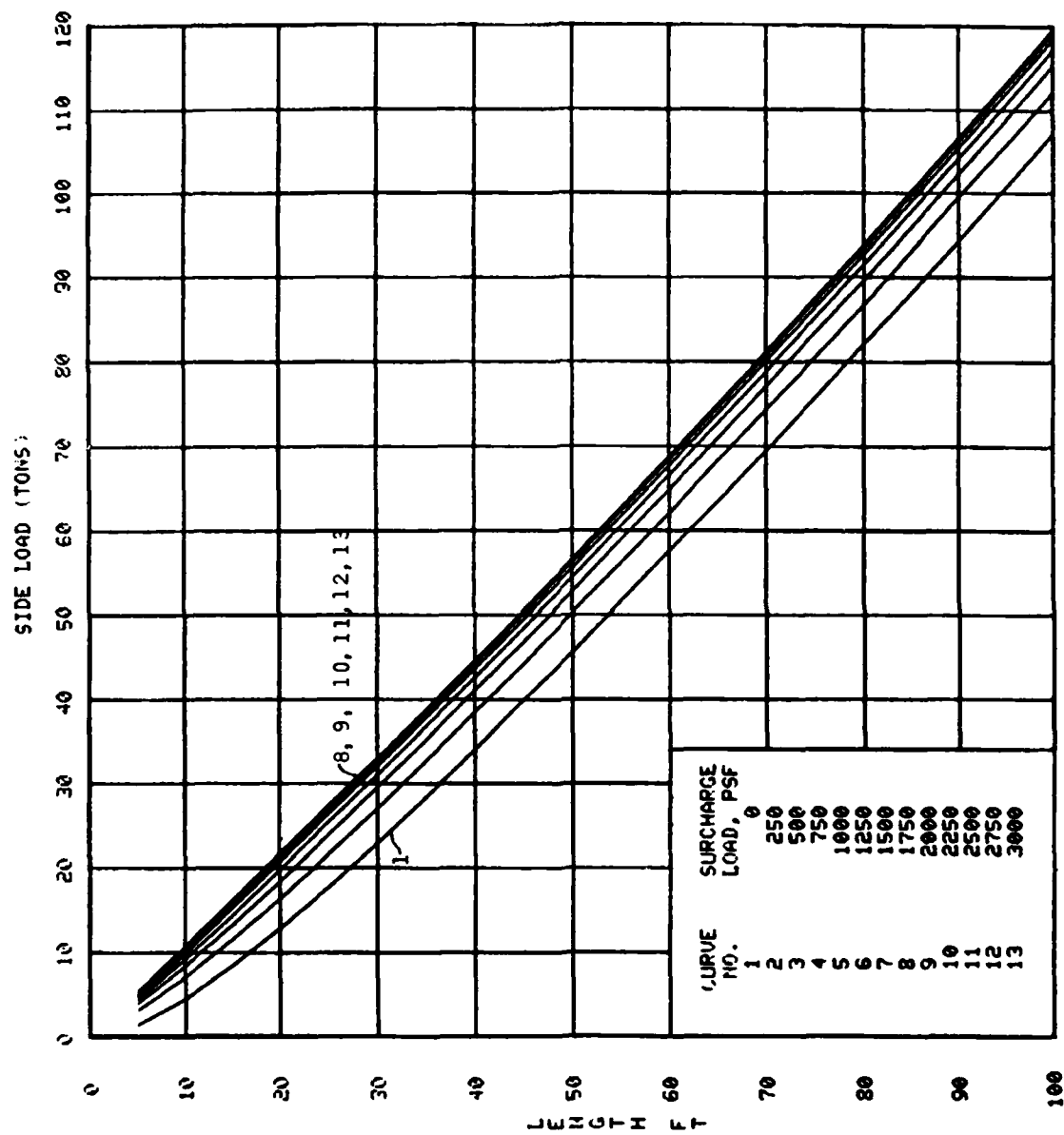


Figure 187. Side Capacity For A 10-in Round Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi=33$  Deg., C-0.



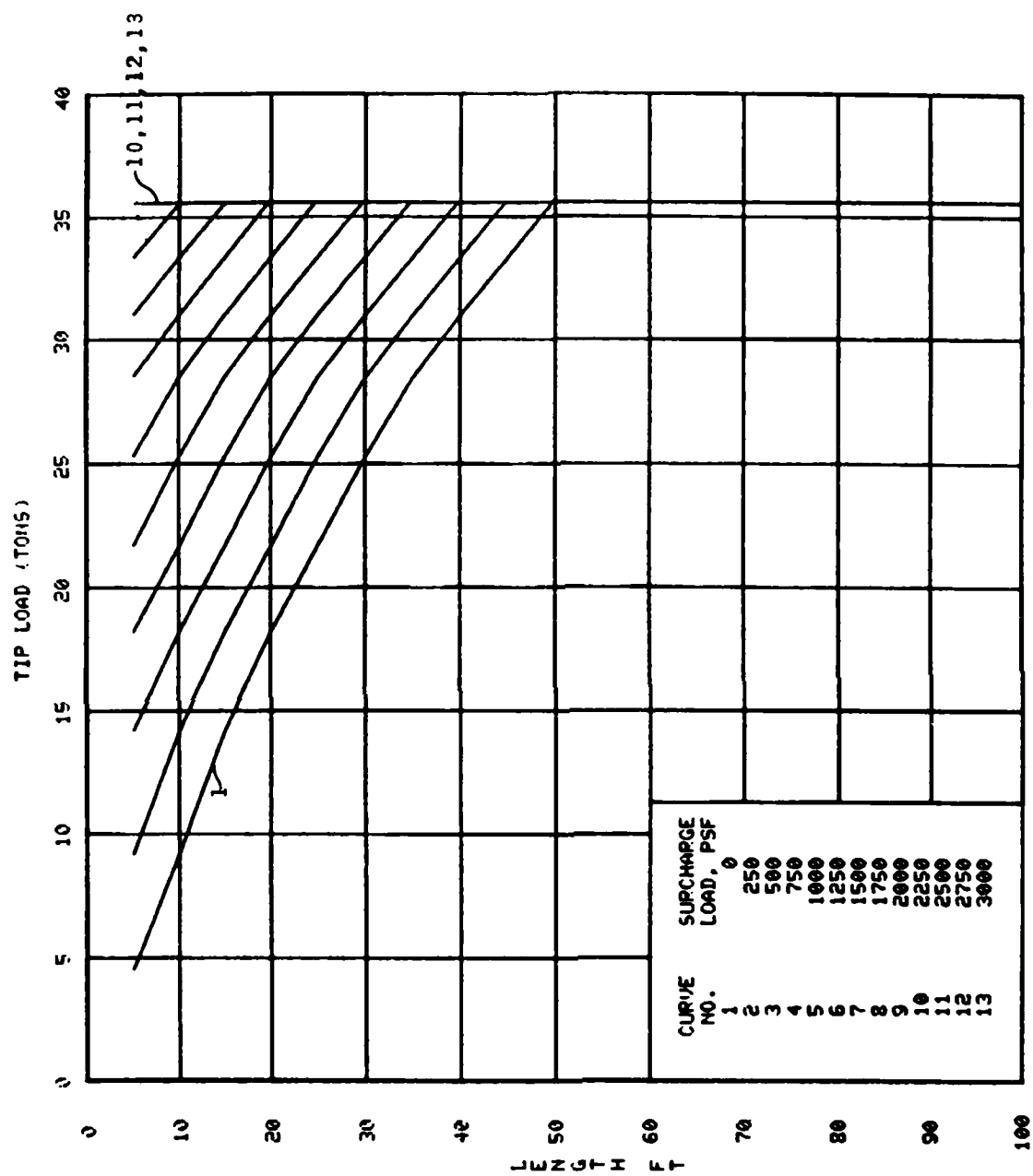


Figure 188. Tip Capacity For A 10-in Round Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi=33$  Deg., C-0.



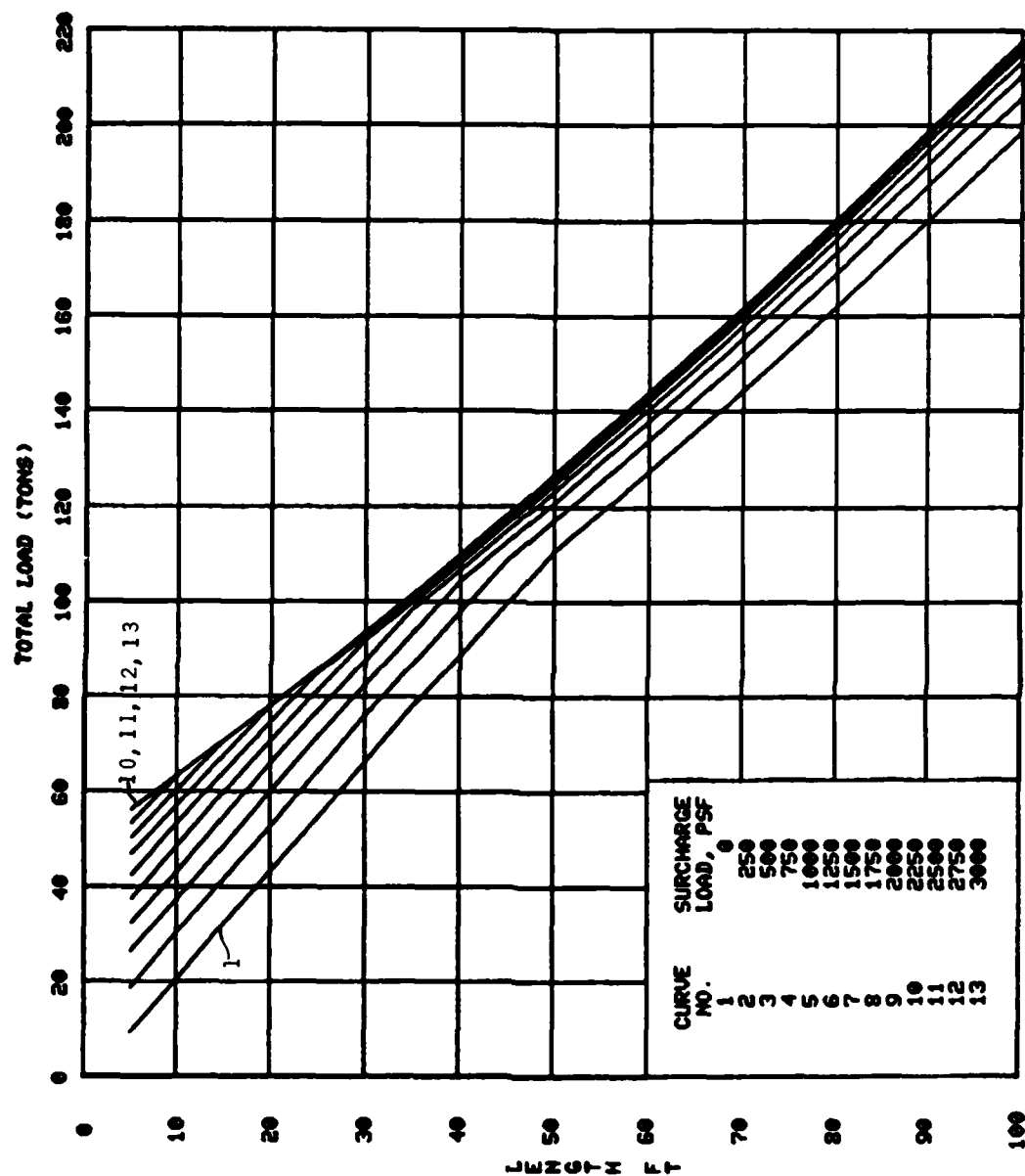


Figure 189. Total Pile Capacity For A 10-in Round Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi=35$  Deg.,  $C=0$ .



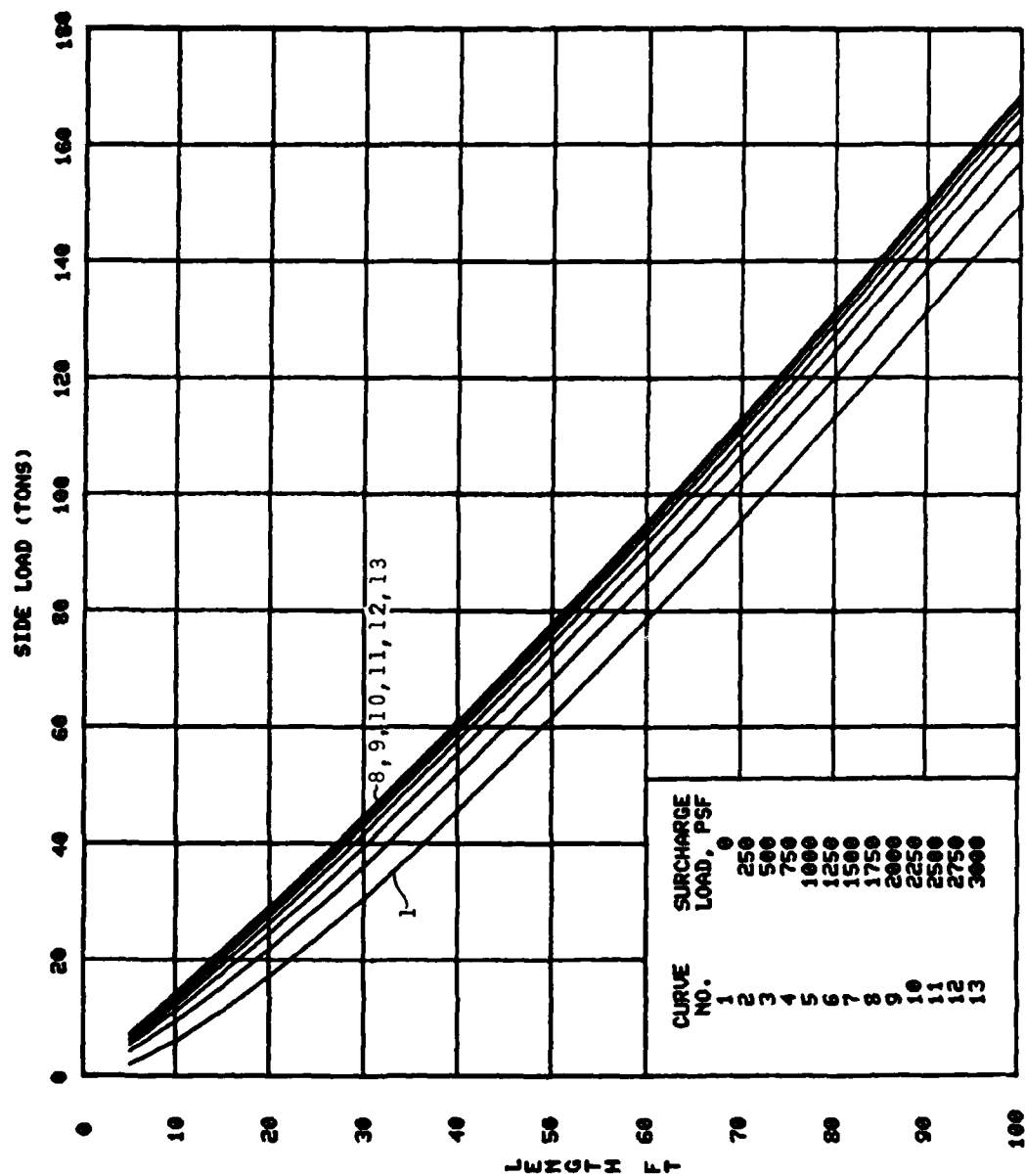


Figure 190. Side Capacity For A 10-in Round Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi=35$  Deg., C-0.



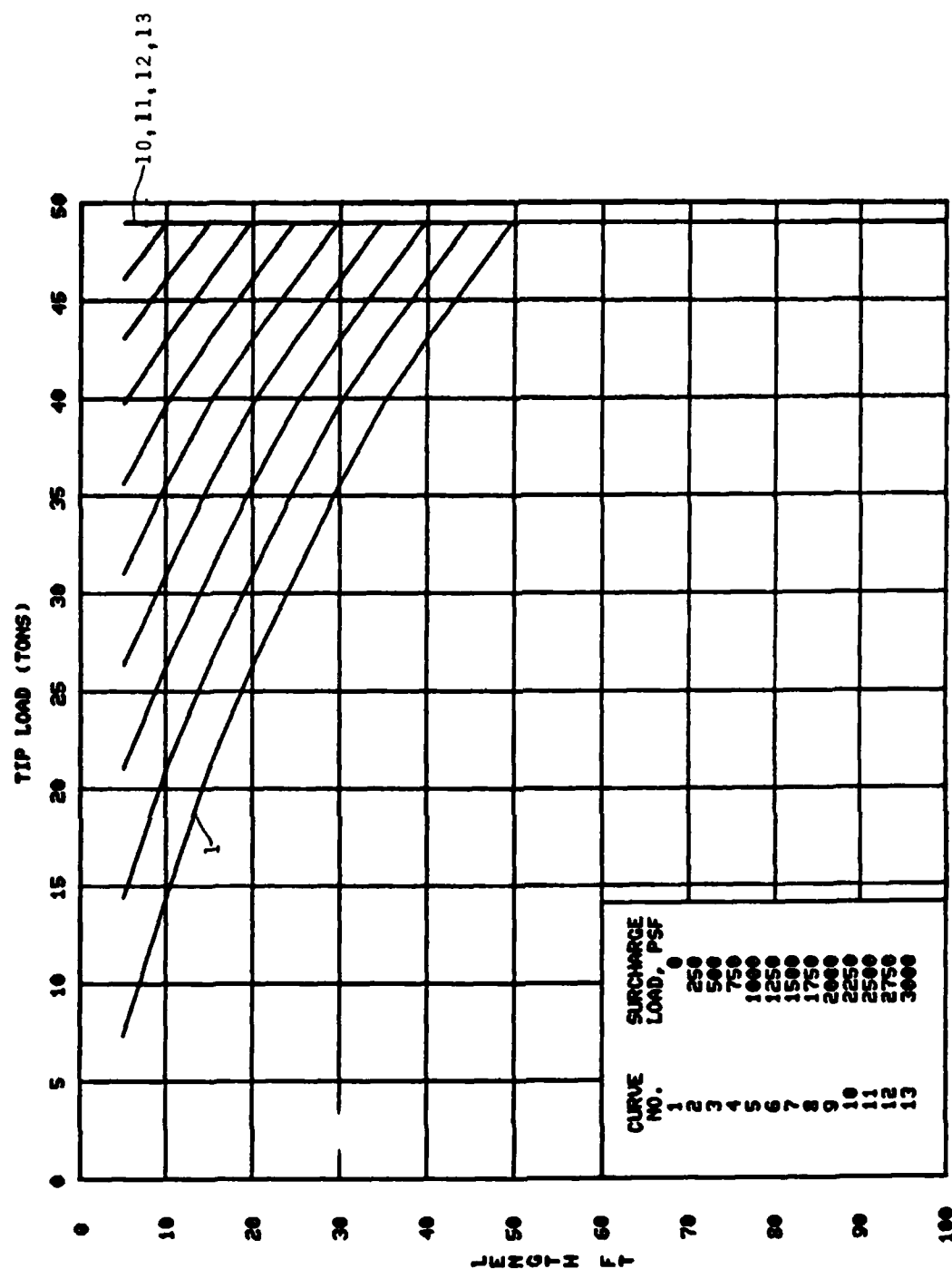


Figure 191. Tip Capacity For A 10-in Round Concrete Pile, Submerged Condition,  $1\frac{1}{4}$ -in. Tip Movement,  $\phi=35$  Deg.,  $C=0$ .



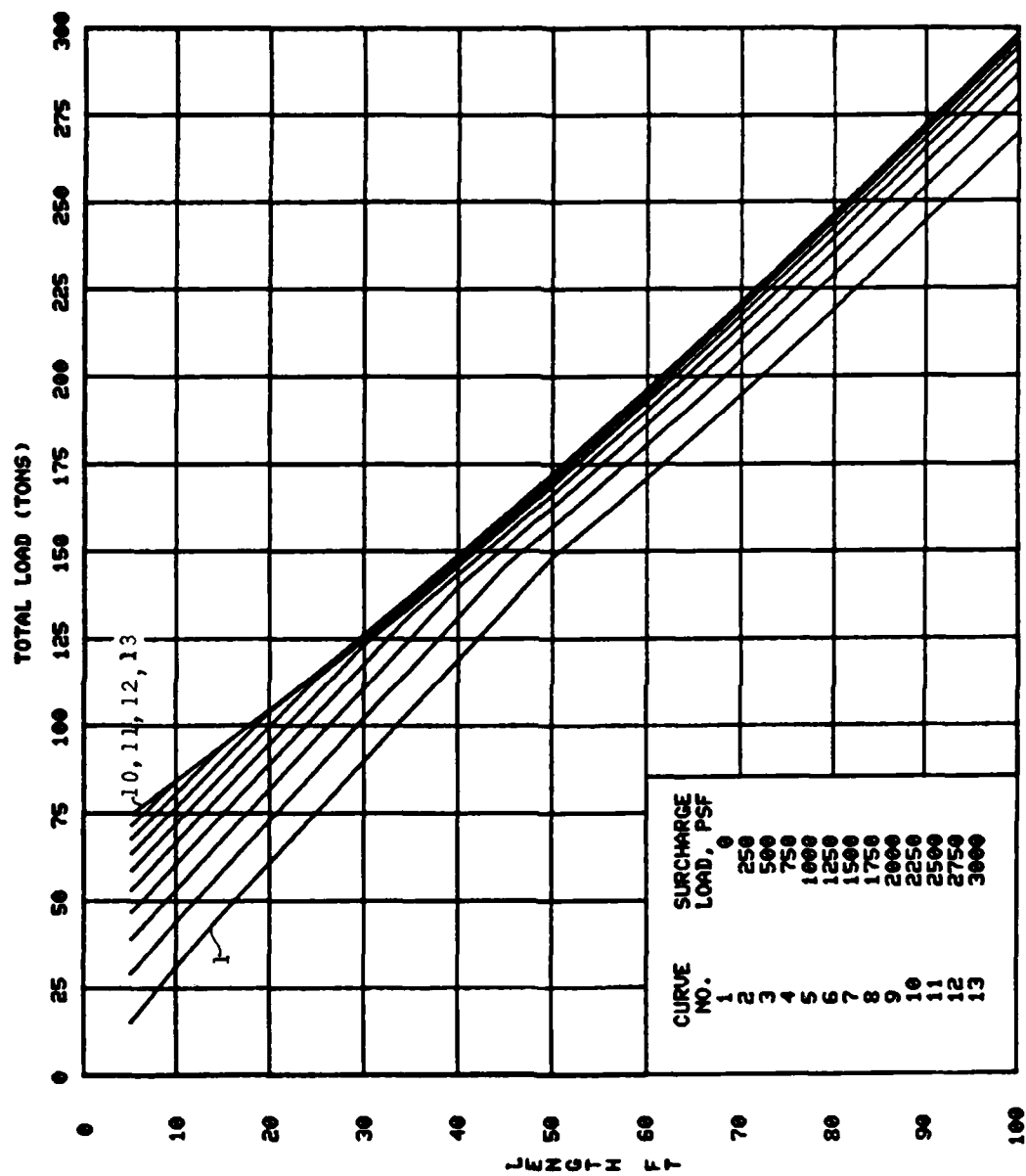


Figure 192. Total Pile Capacity For A 10-in Round Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\phi = 37^\circ$  Deg., C-0.



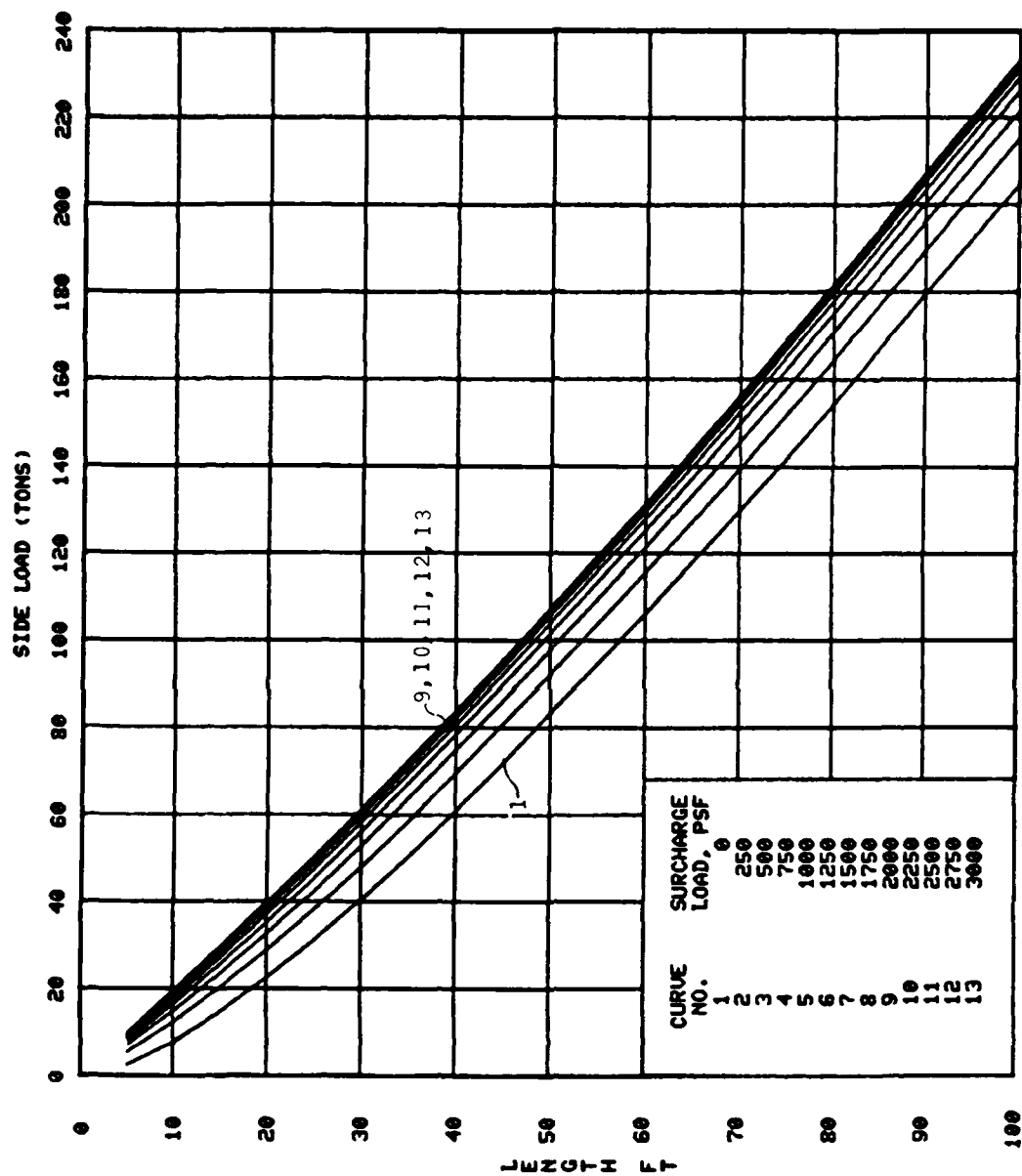


Figure 193. Side Capacity For A 10-in Round Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi=37^\circ$  Deg., C-0.



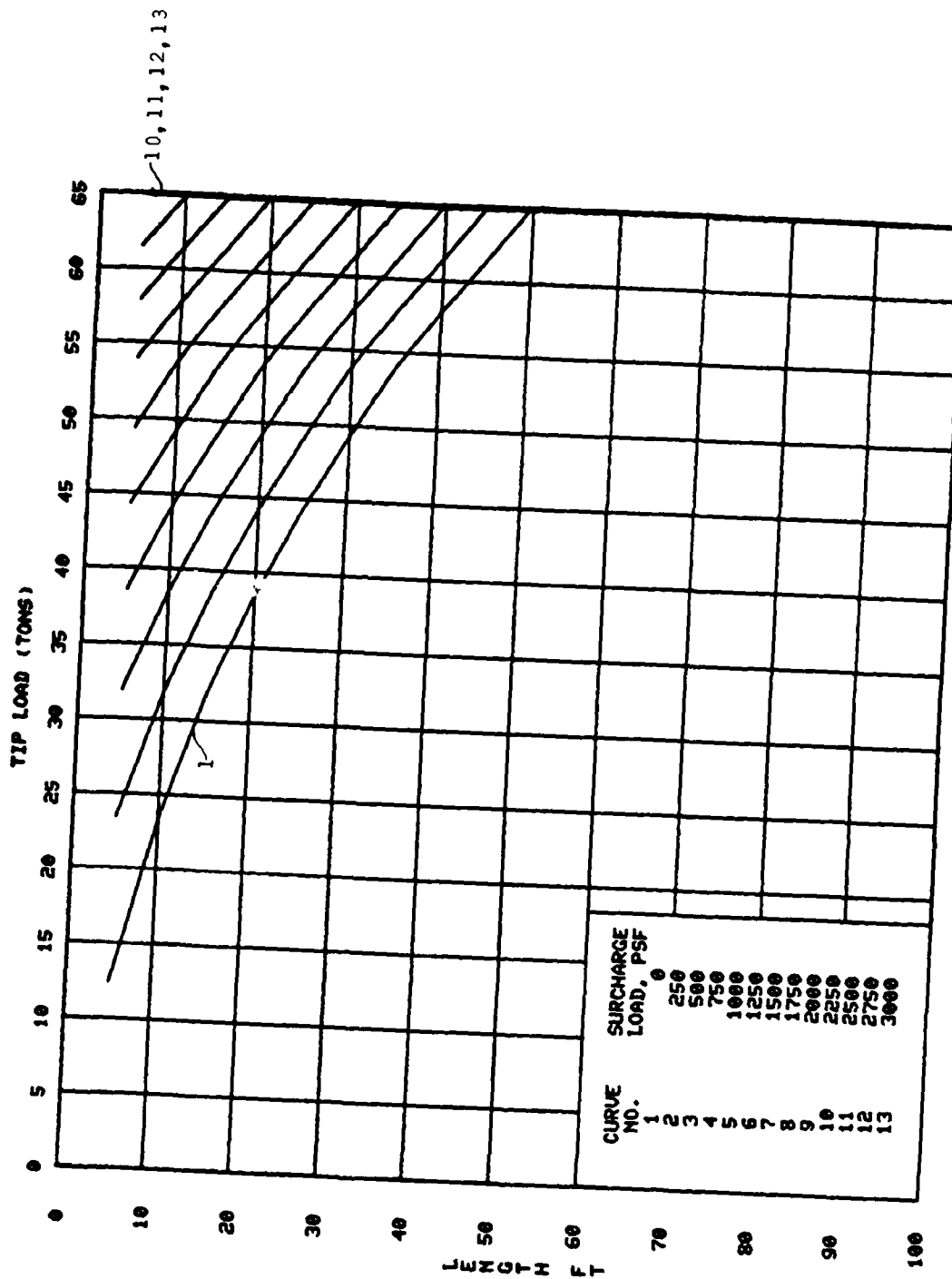


Figure 194. Tip Capacity For A 10-in Round Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi=37^\circ$ ,  $C=0$ .



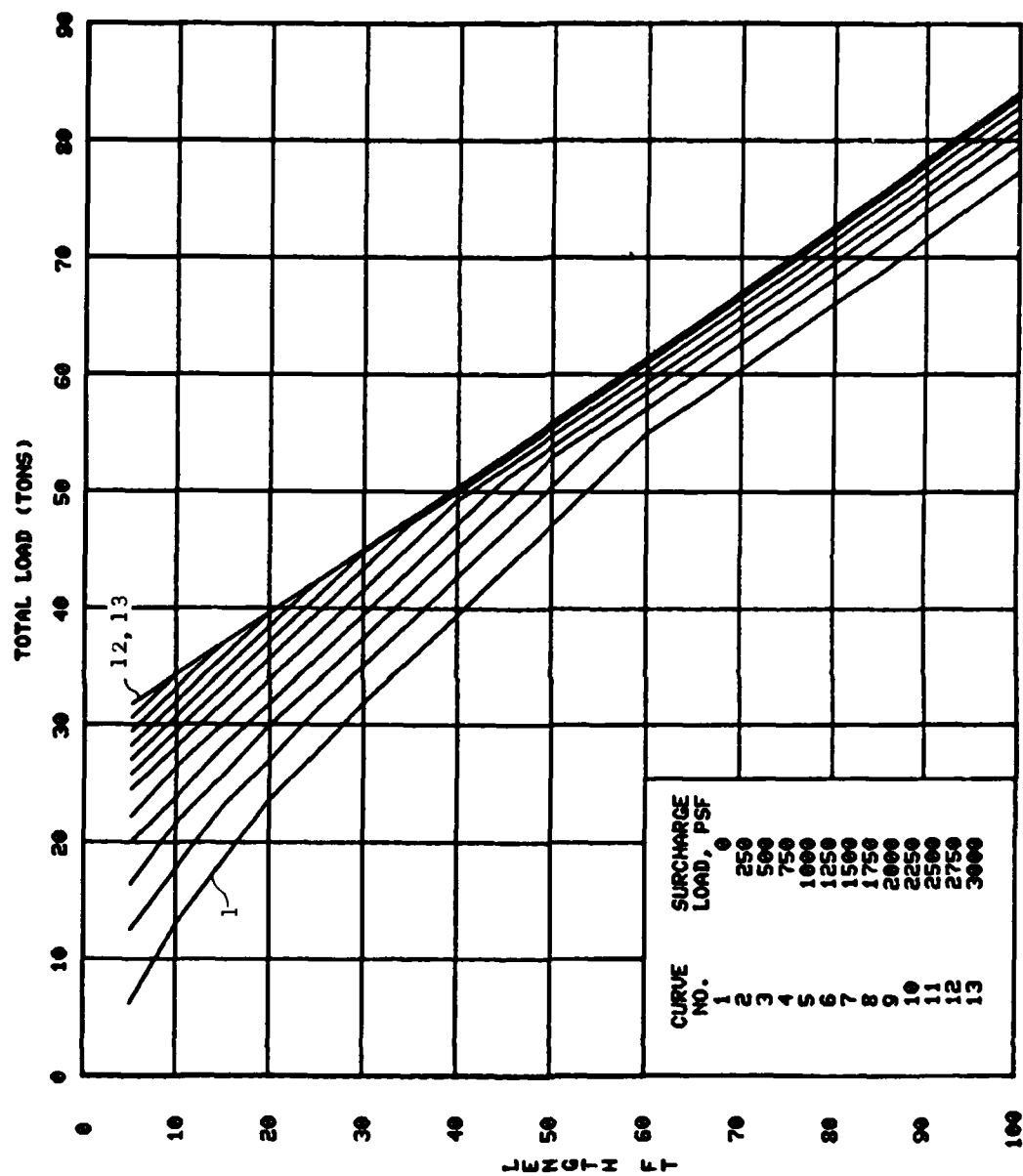


Figure 195. Total Pile Capacity For A 12-in Round Concrete Pile. Submerged Condition, 1/4-in. Tip Movement,  $\Phi$ 1-30 Deg., C-0.



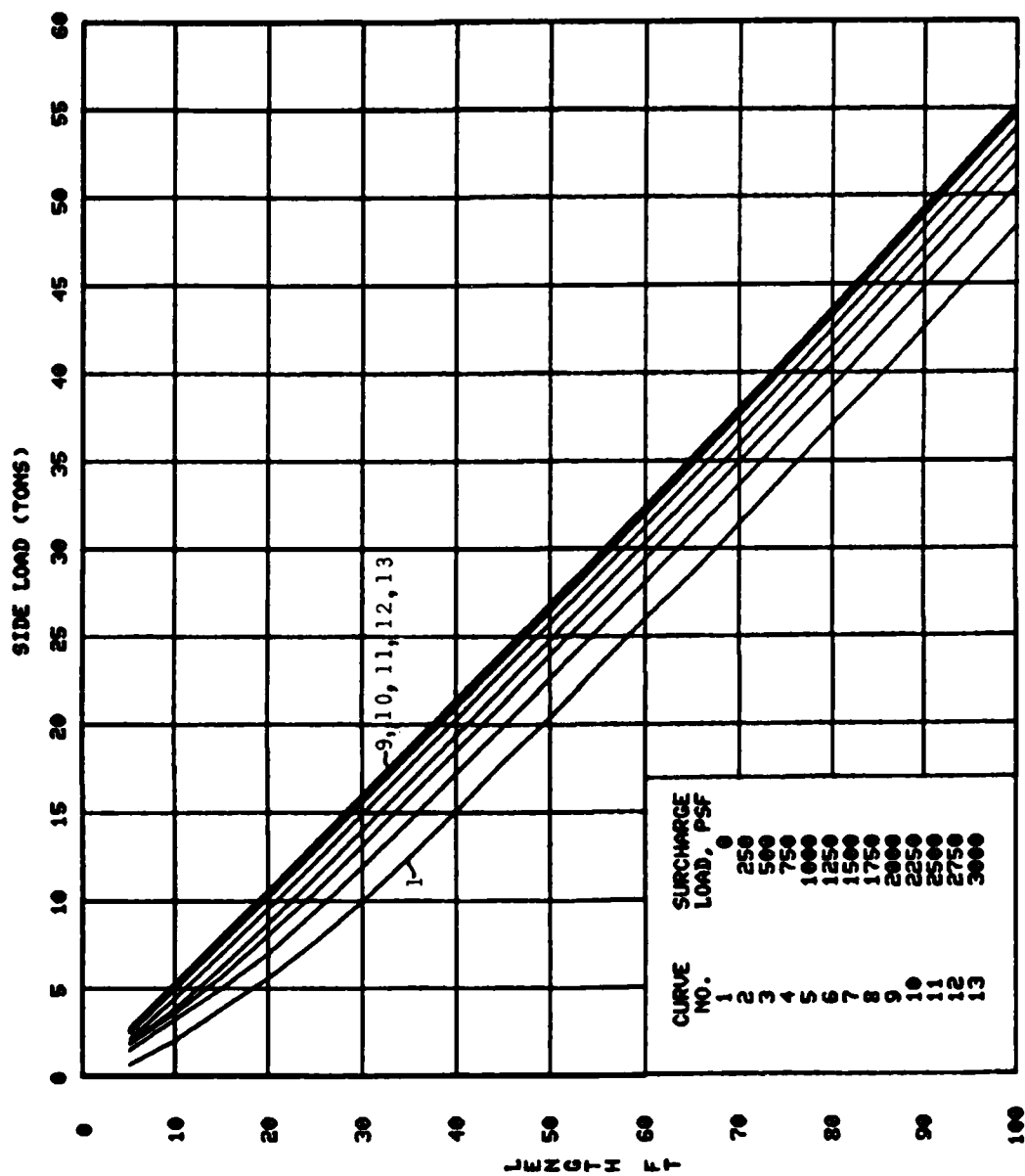


Figure 196. Side Capacity For A 12-in Round Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi=30^\circ$ , C-6.



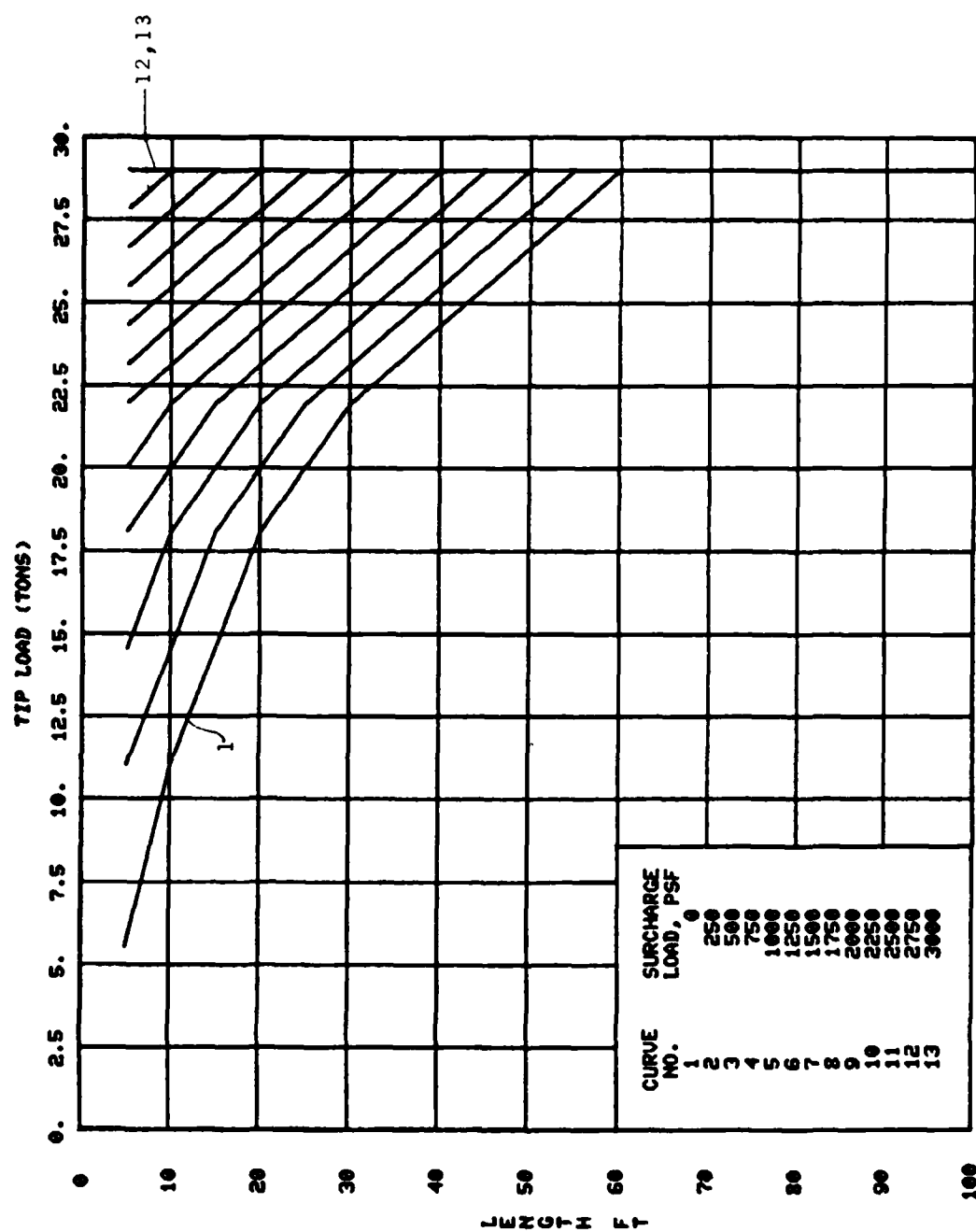


Figure 197. Tip Capacity For A 12-in Round Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi$ 1-30 Deg., C-0.



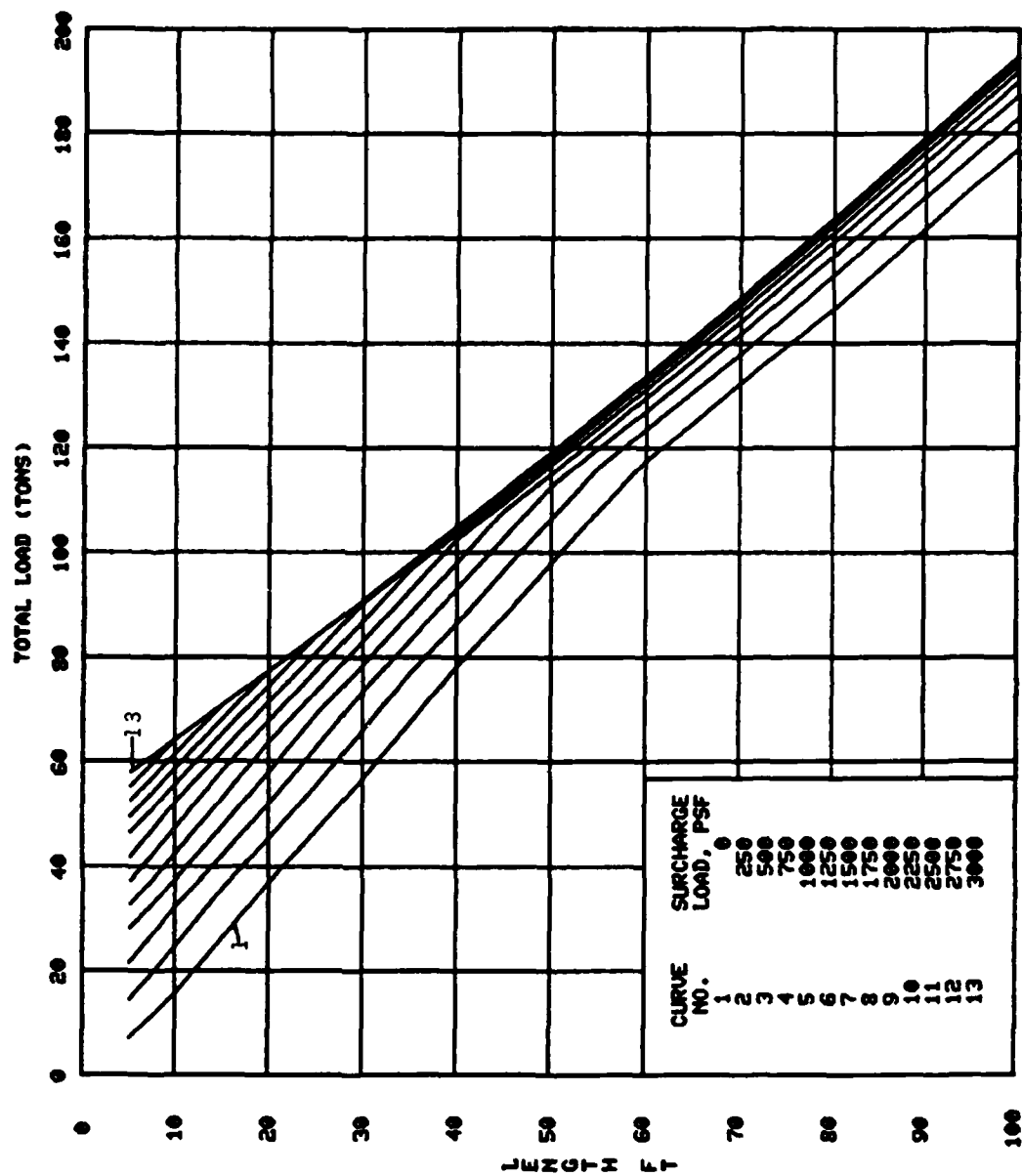


Figure 198. Total Pile Capacity For A 12-in Round Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\phi=33$  Deg., C-0.



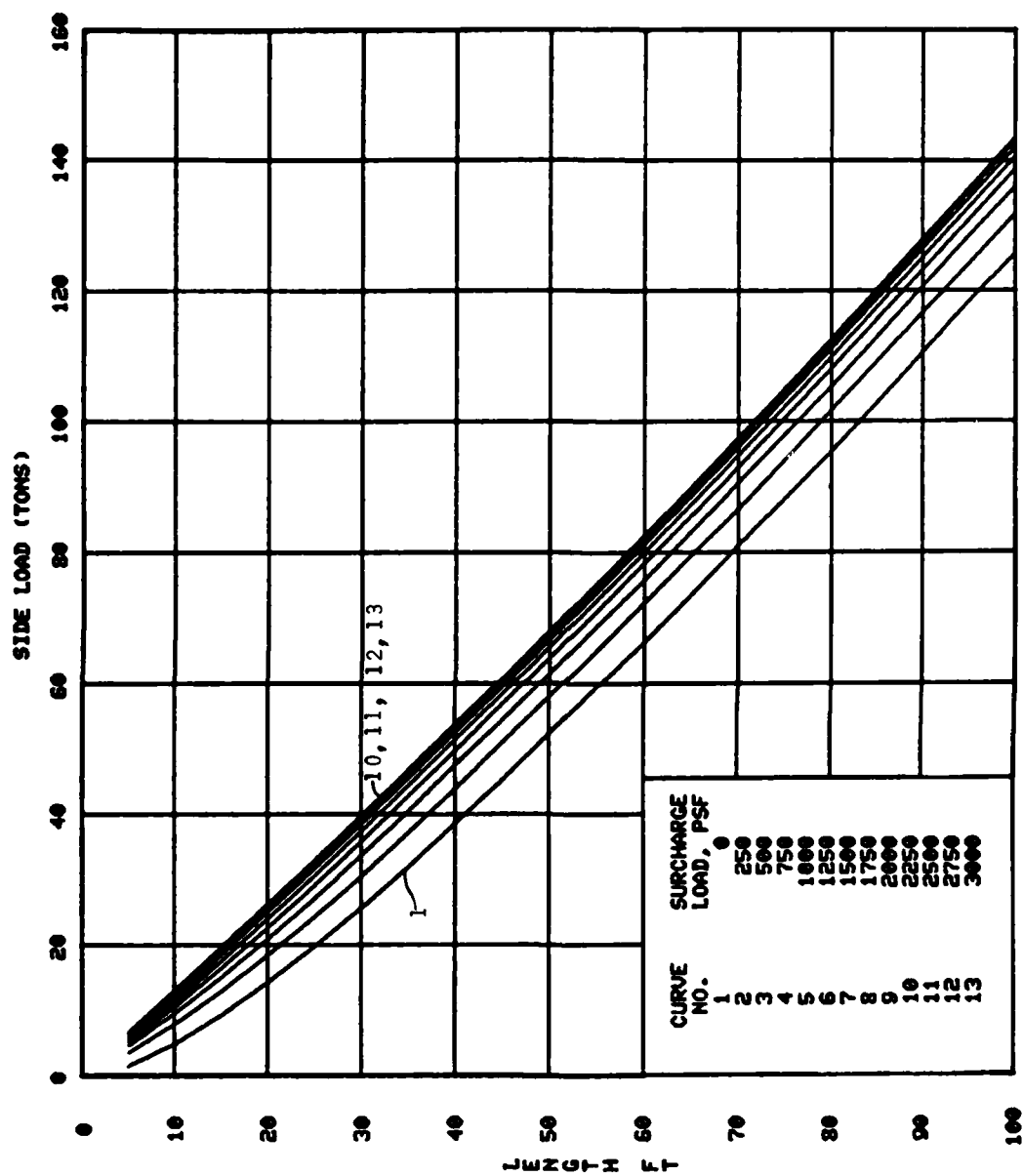


Figure 199. Side Capacity For A 12-in Round Concrete Pile, Submerged Condition, 1/4-in. Tip Movement, Phi-33 Deg., C-6.



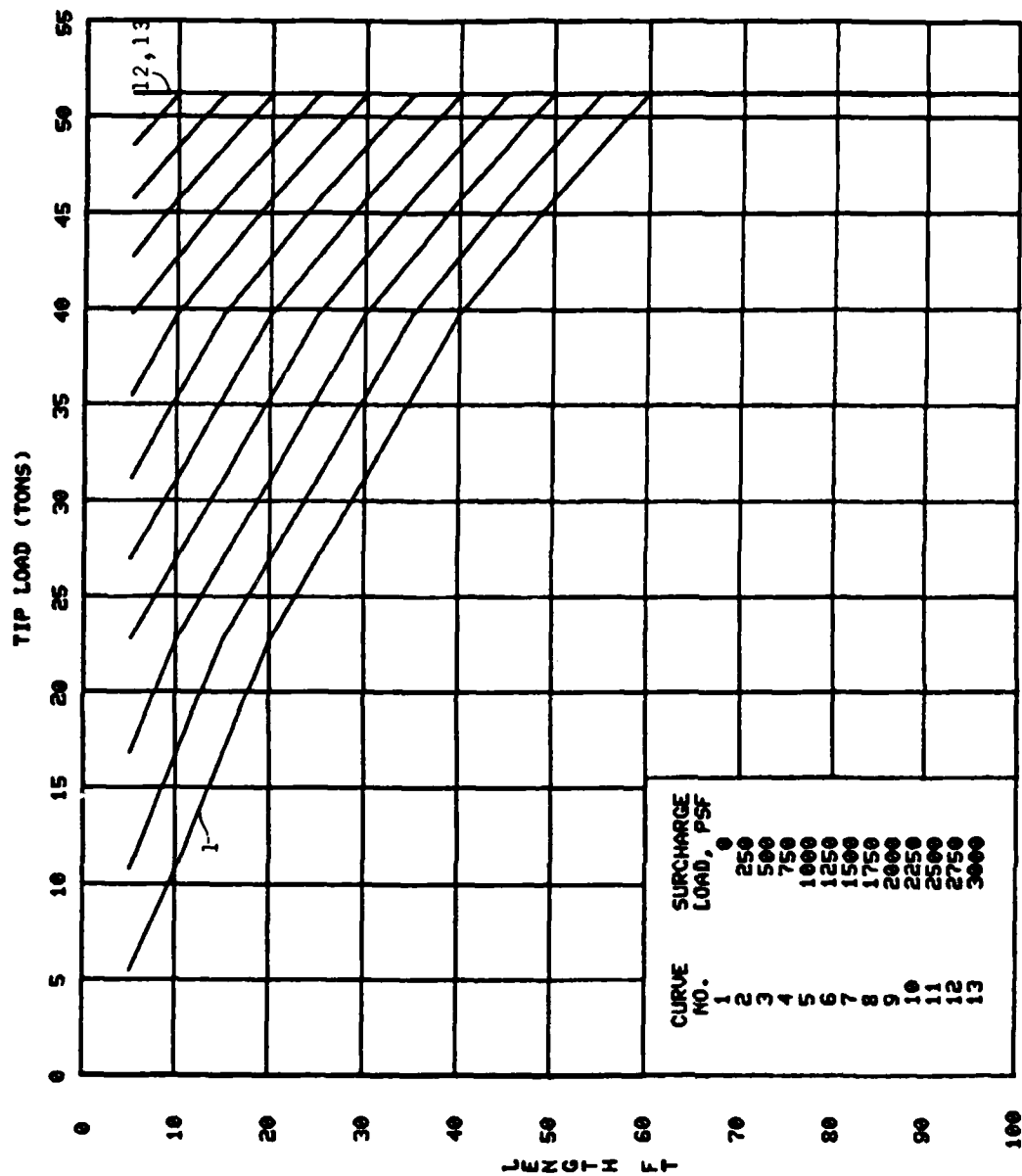


Figure 200. Tip Capacity For A 12-in Round Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi 1-33$  Deg., C-0.



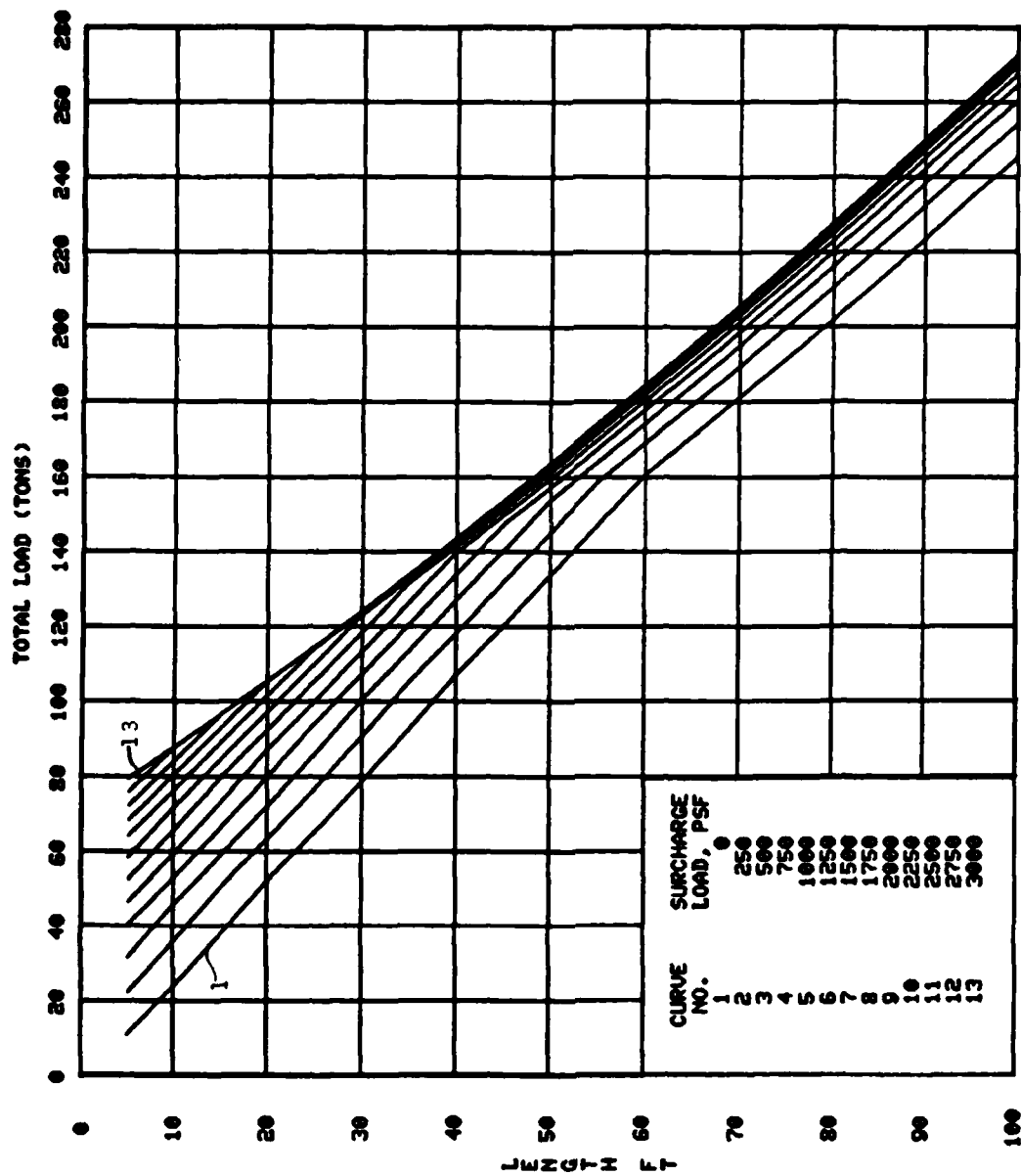


Figure 201. Total Pile Capacity For A 12-in Round Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi$ 1-3S Deg., C-6.



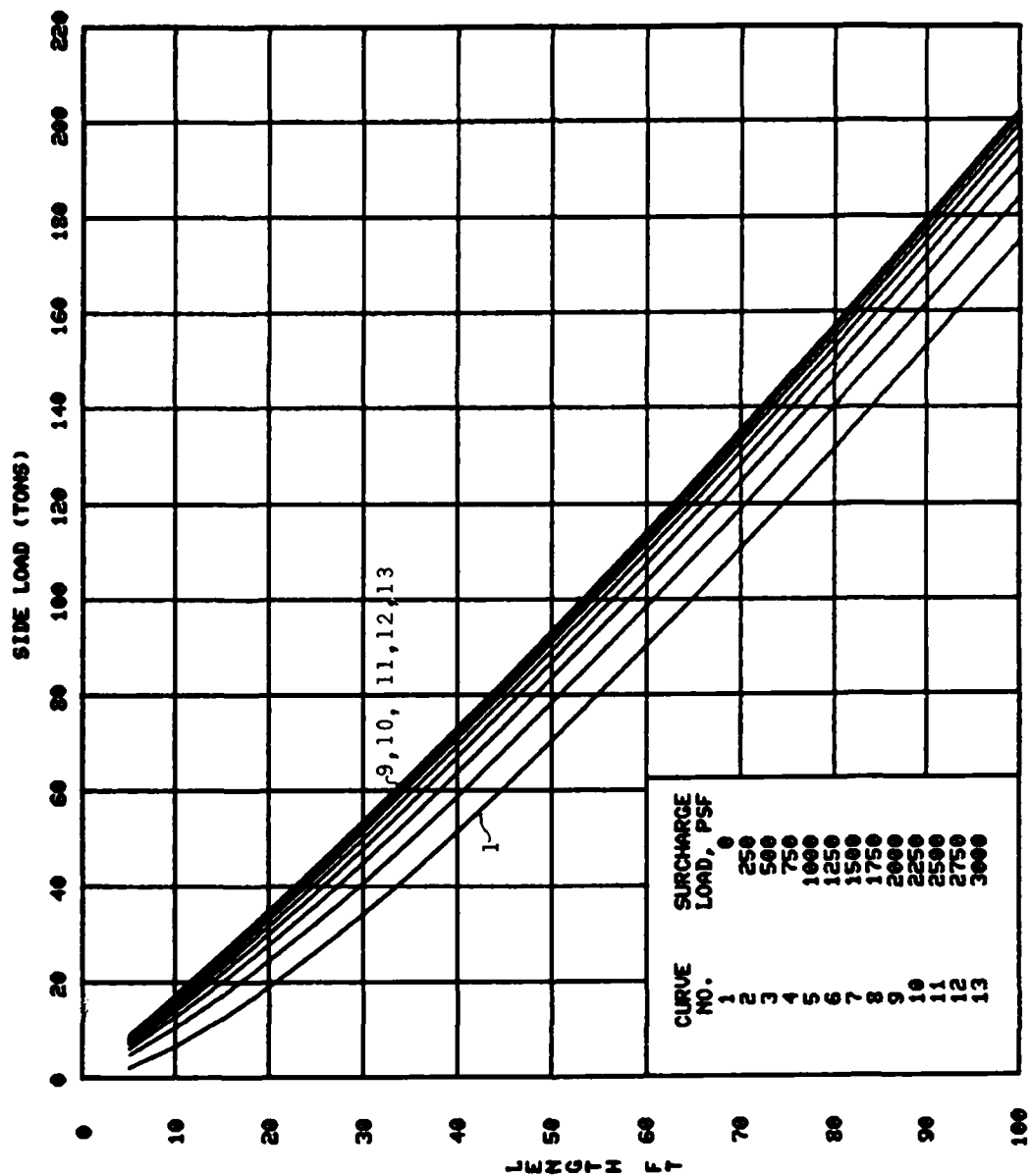


Figure 202. Side Capacity For A 12-in Round Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi=35$  Deg.,  $C=0$ .



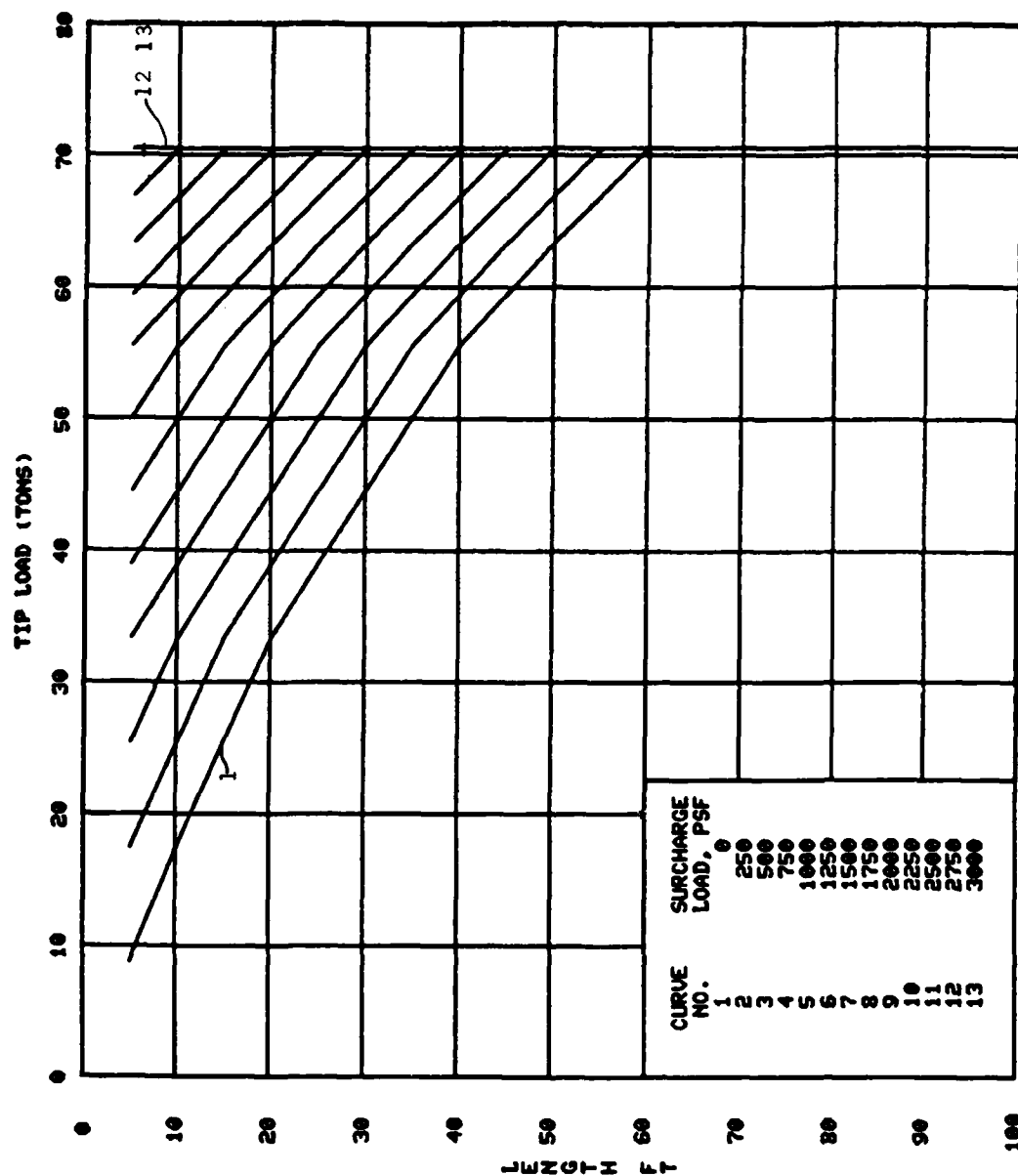


Figure 203. Tip Capacity For A 12-in Round Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\phi$ 1-35 Deg., C-0.



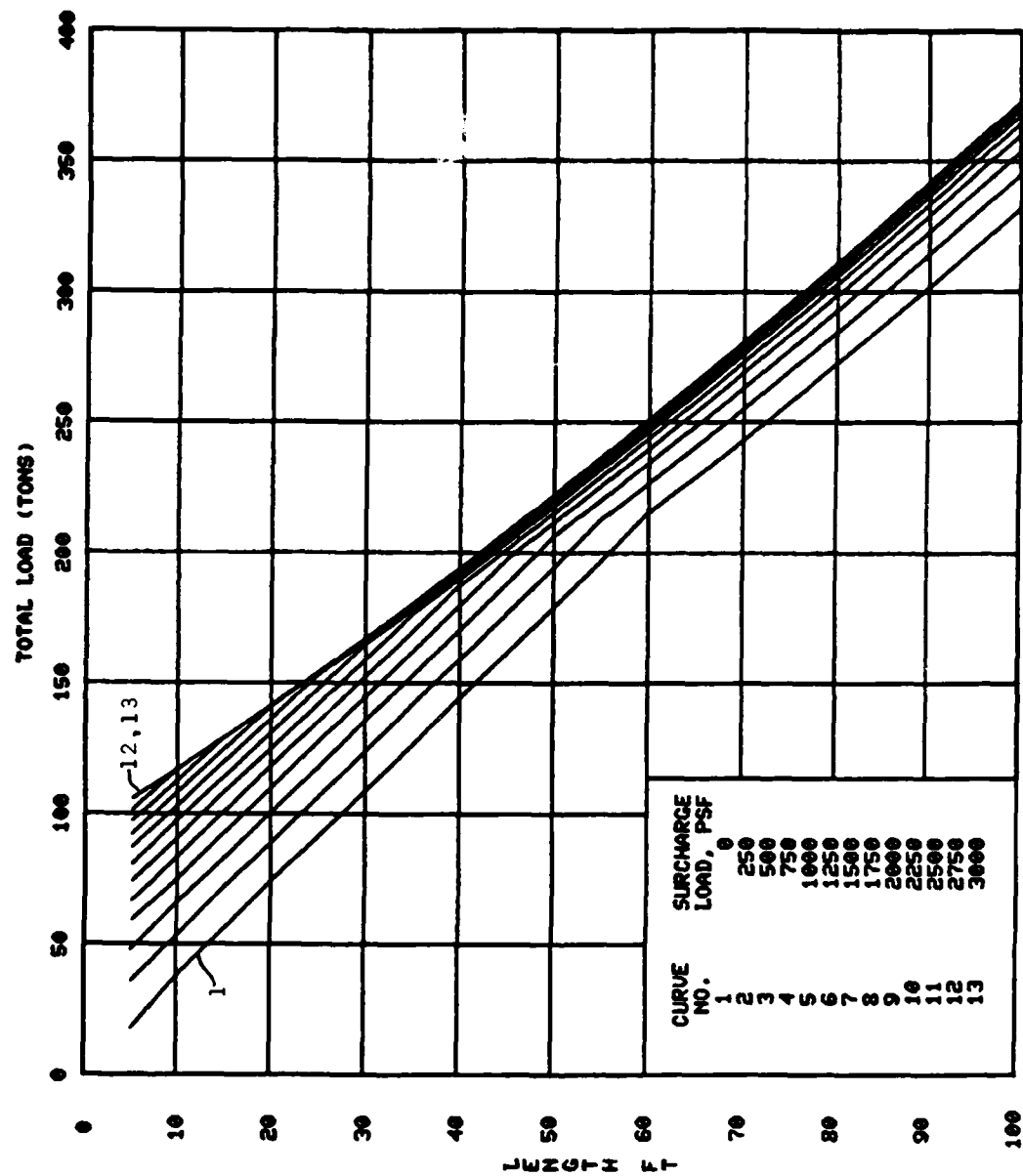


Figure 204. Total Pile Capacity For A 12-in Round Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\phi$ 1-37 Deg., C-0.



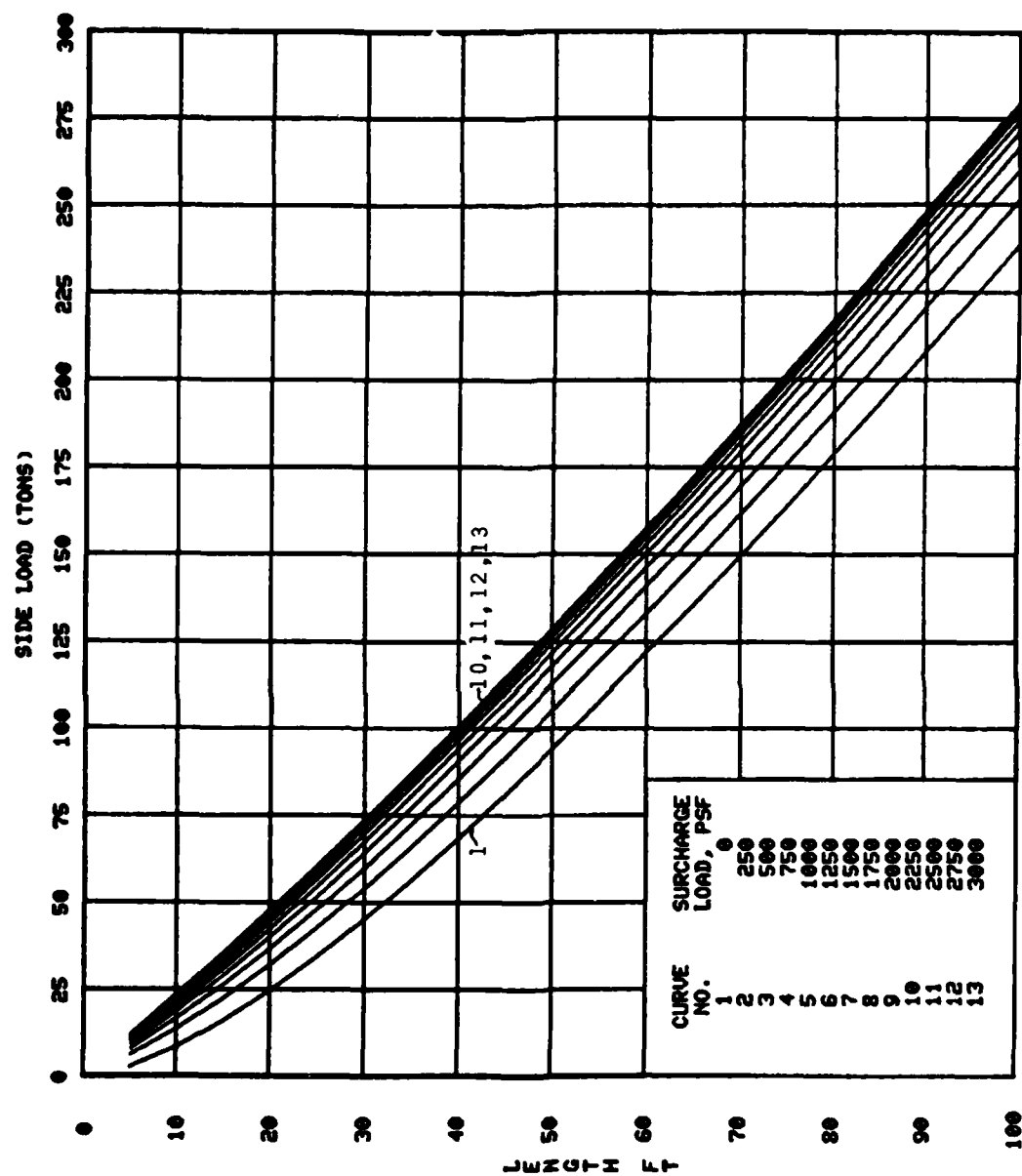


Figure 205. Side Capacity For A 12-in Round Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi_{1-37}$  Deg., C-0.



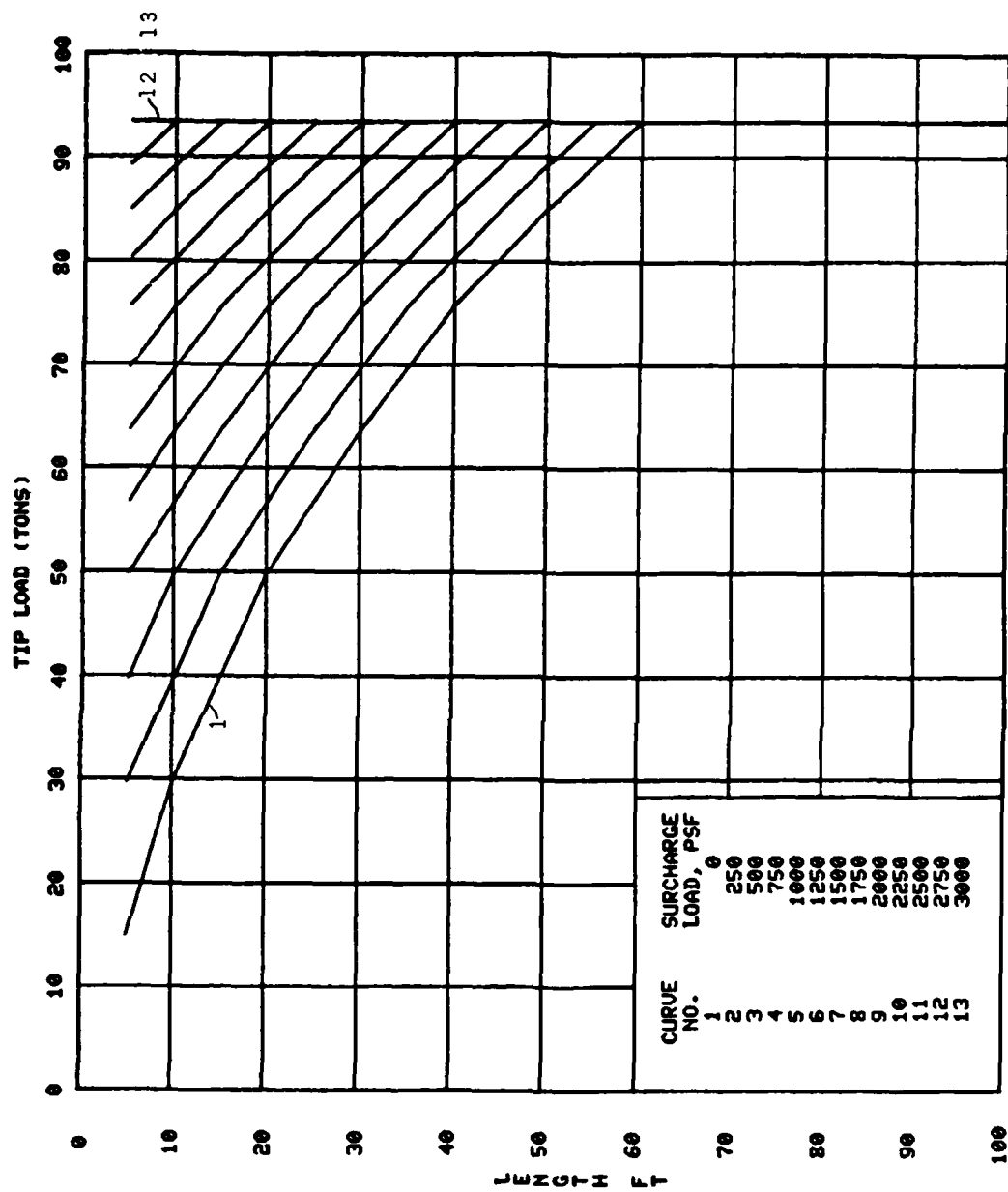


Figure 206. Tip Capacity For A 12-in Round Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi$ 1-37 Deg., C-0.



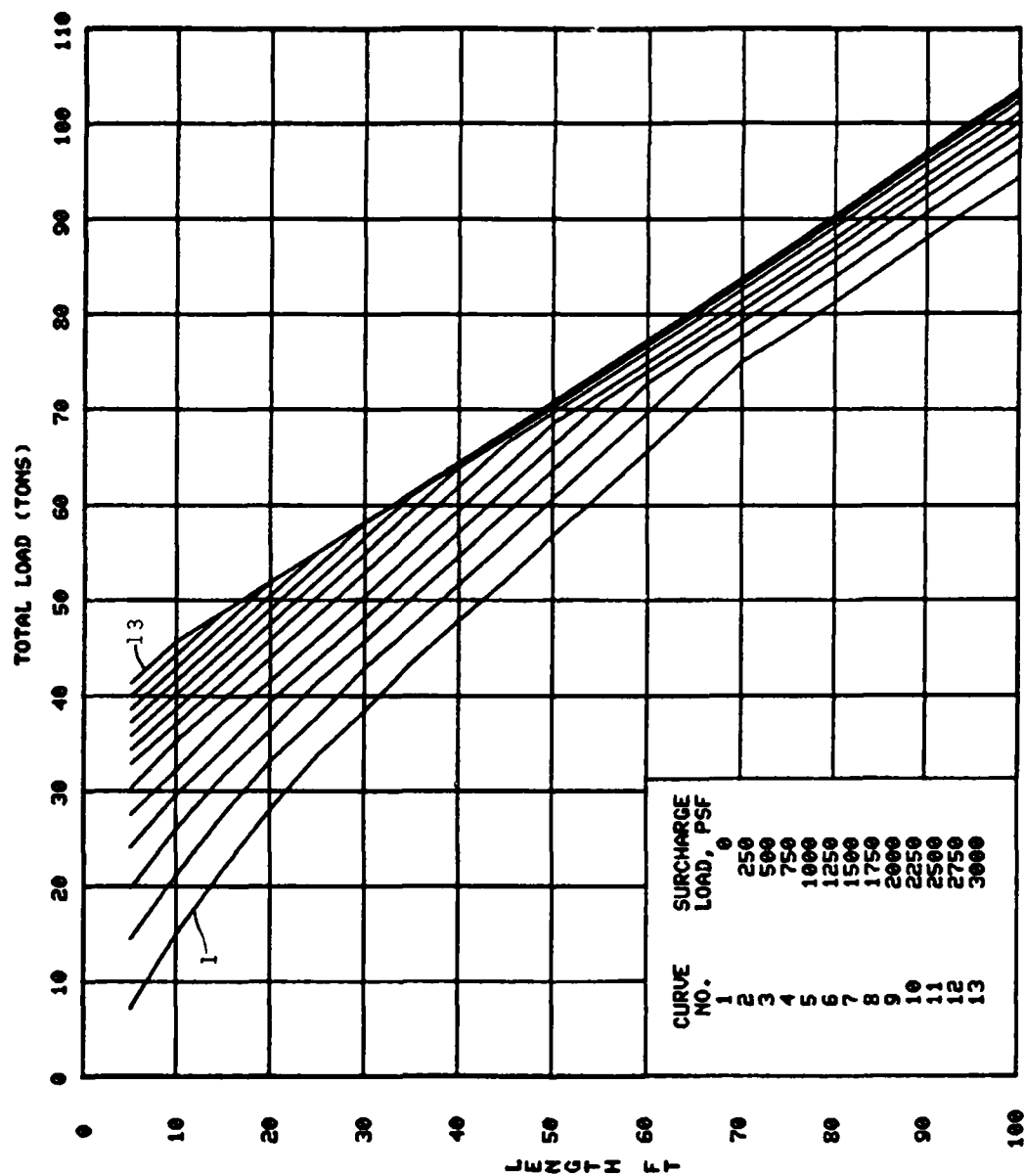


Figure 207. Total Pile Capacity For A 14-in Round Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi=30$  Deg., C-0.



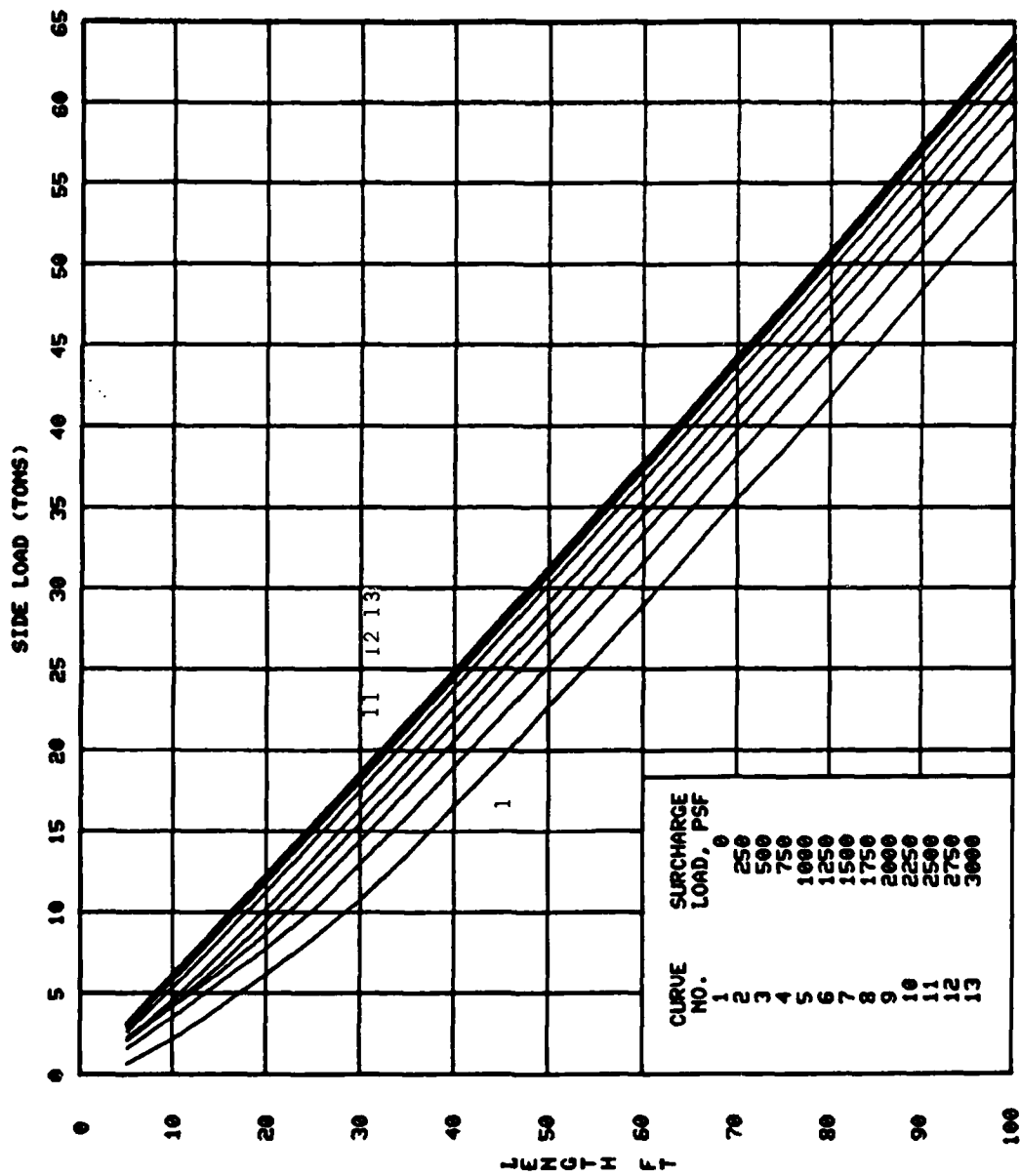


Figure 208. Side Capacity For A 14-in Round Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi 1-30$  Deg., C-0.



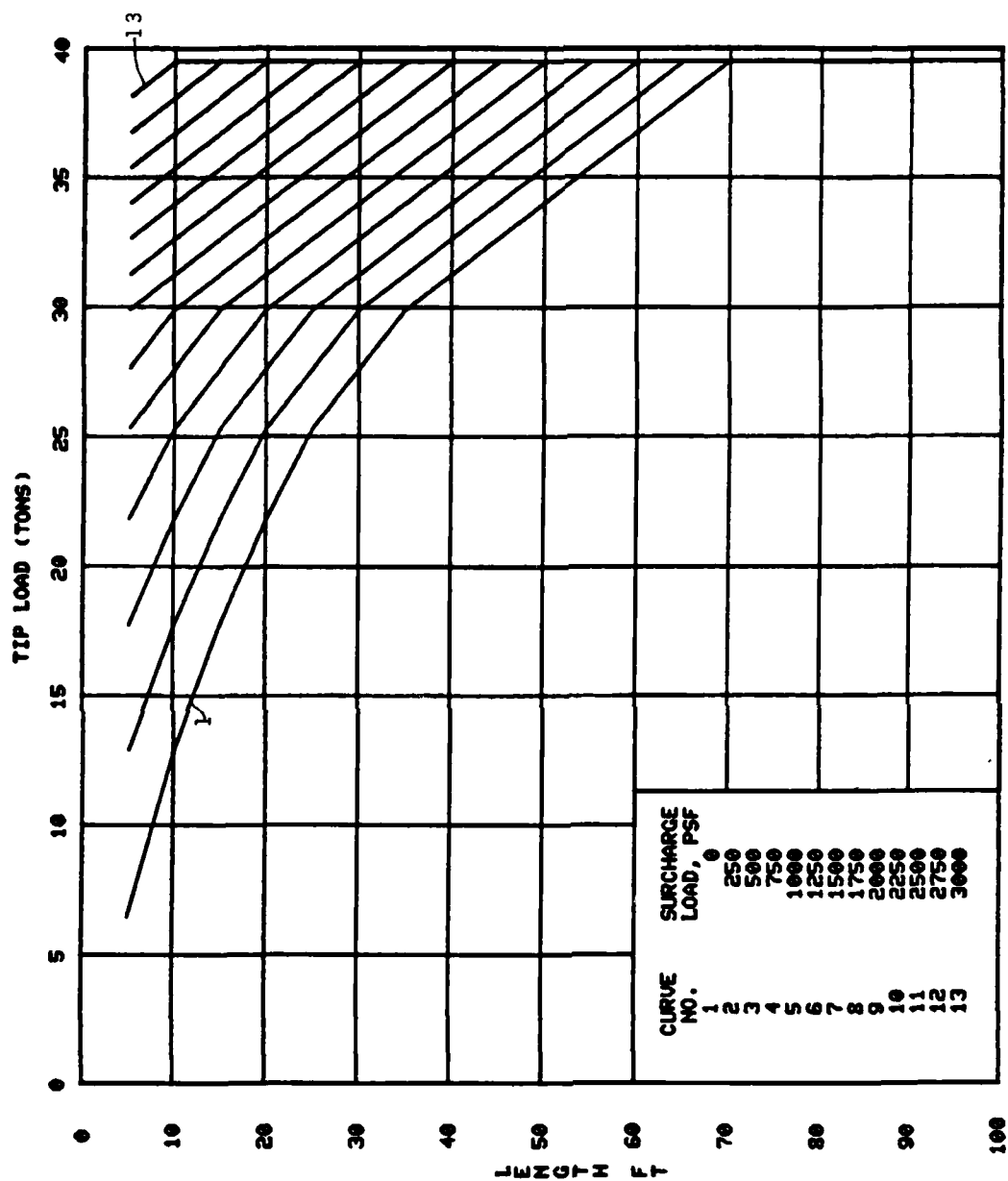


Figure 209. Tip Capacity For A 14-in Round Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi$ 1-30 Deg., C-0.



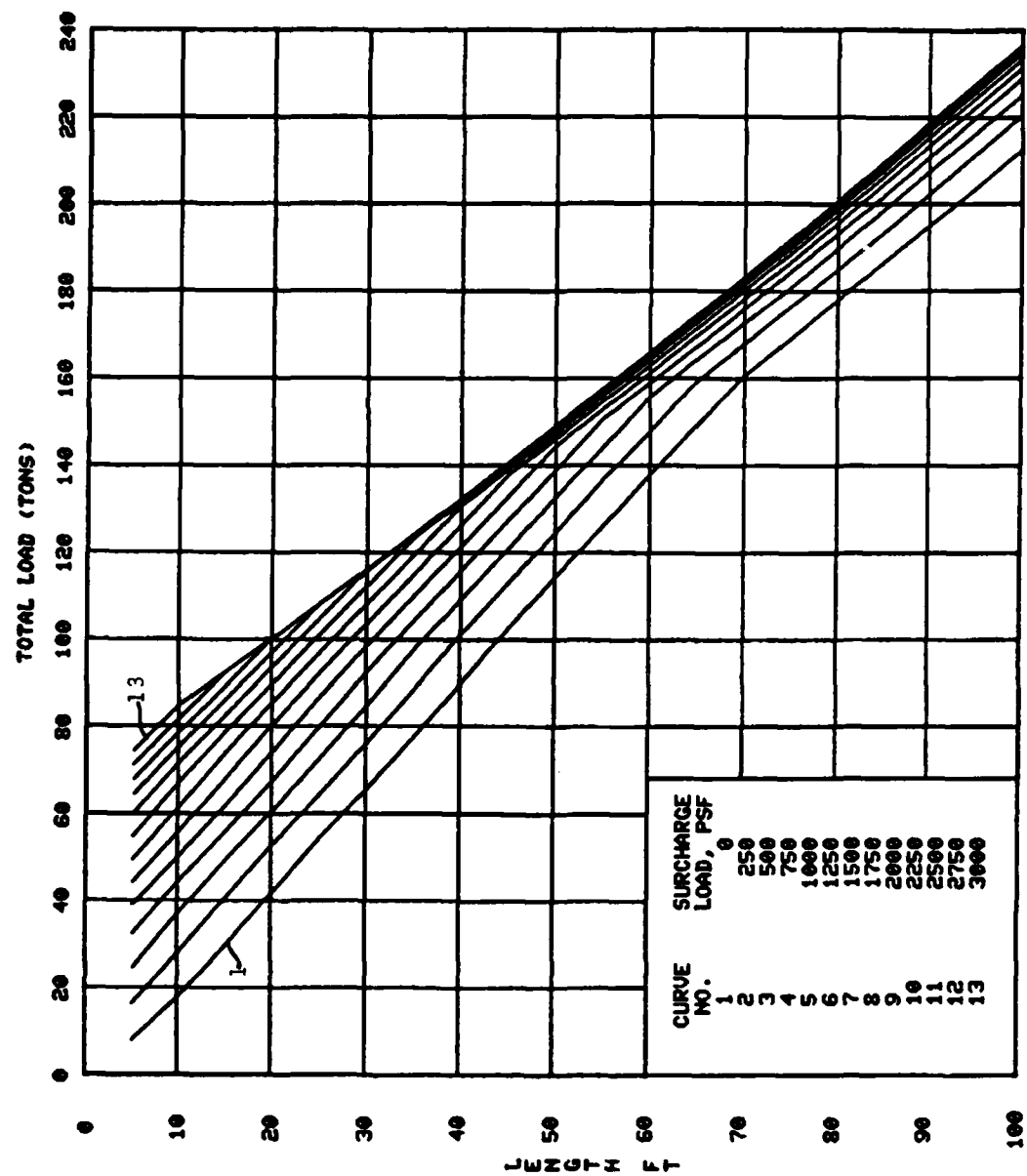


Figure 210. Total Pile Capacity For A 14-in Round Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi$ 1-33 Deg., C-6.



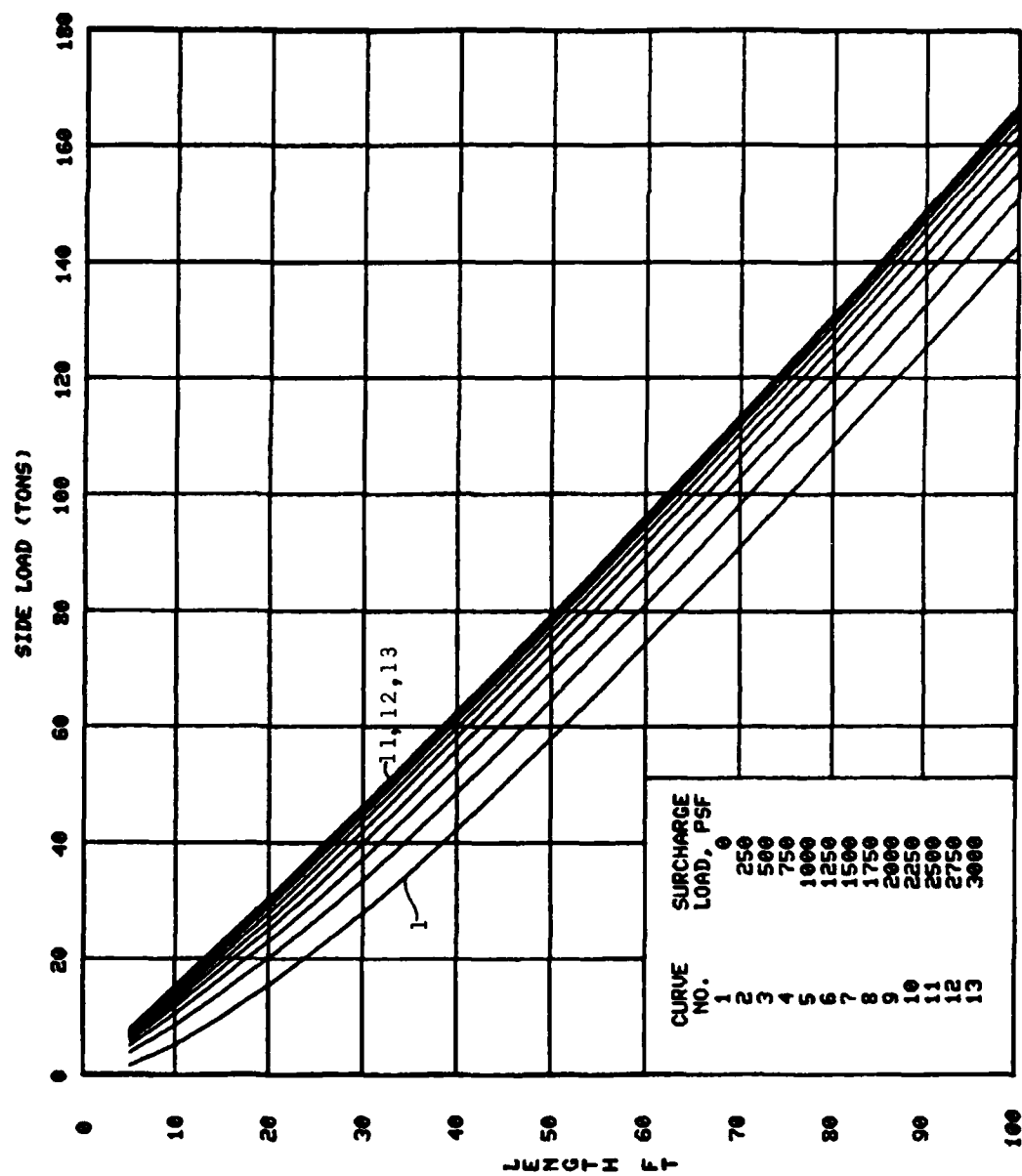


Figure 211. Side Capacity For A 14-in Round Concrete Pile, Submerged Condition, 1/4-in. Tip Movement, Phi-33 Deg., C-0.



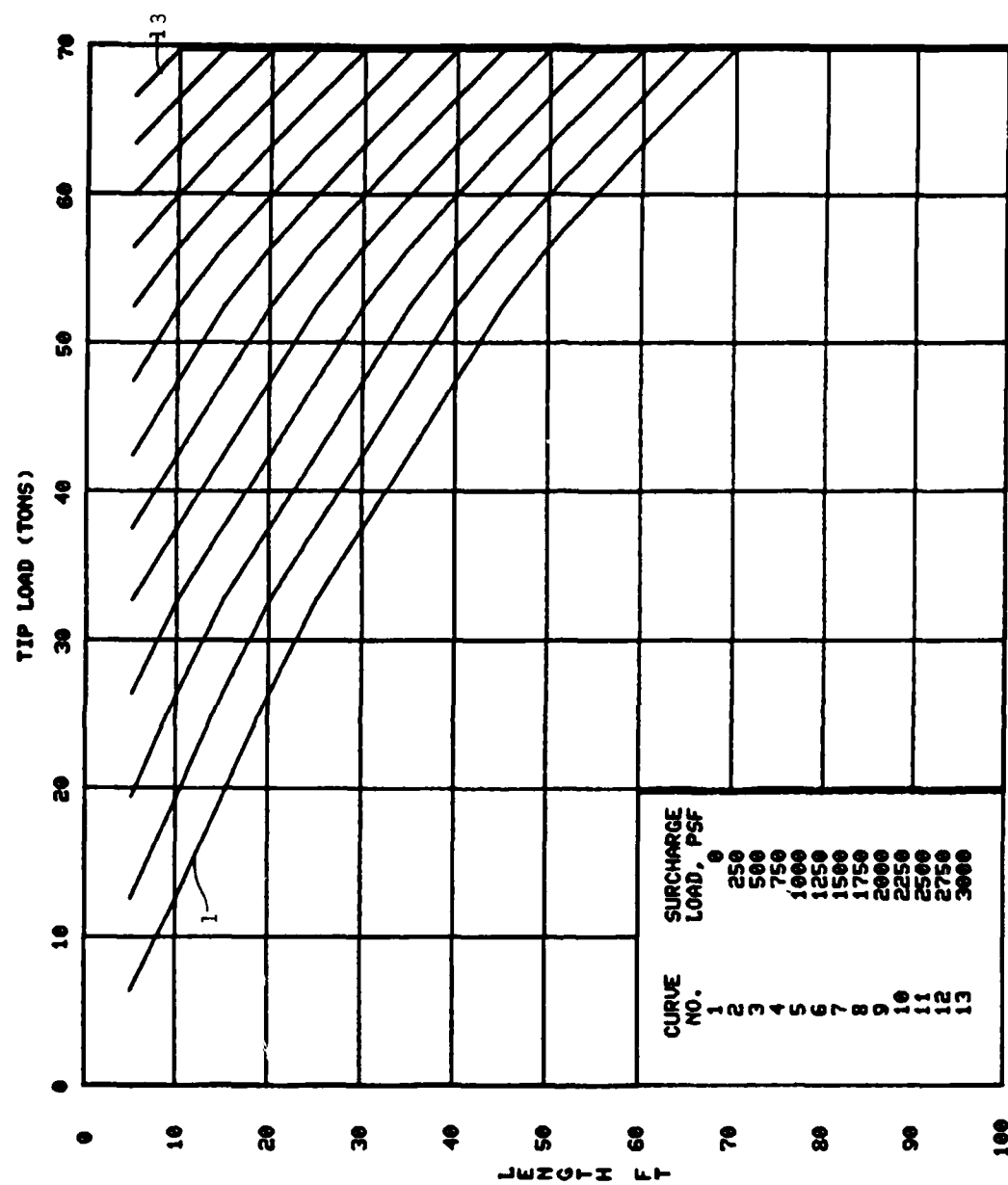


Figure 212. Tip Capacity For A 14-in Round Concrete Pile.  
Submerged Condition, 1/4-in. Tip Movement,  $\Phi$ -33 Deg., C-0.



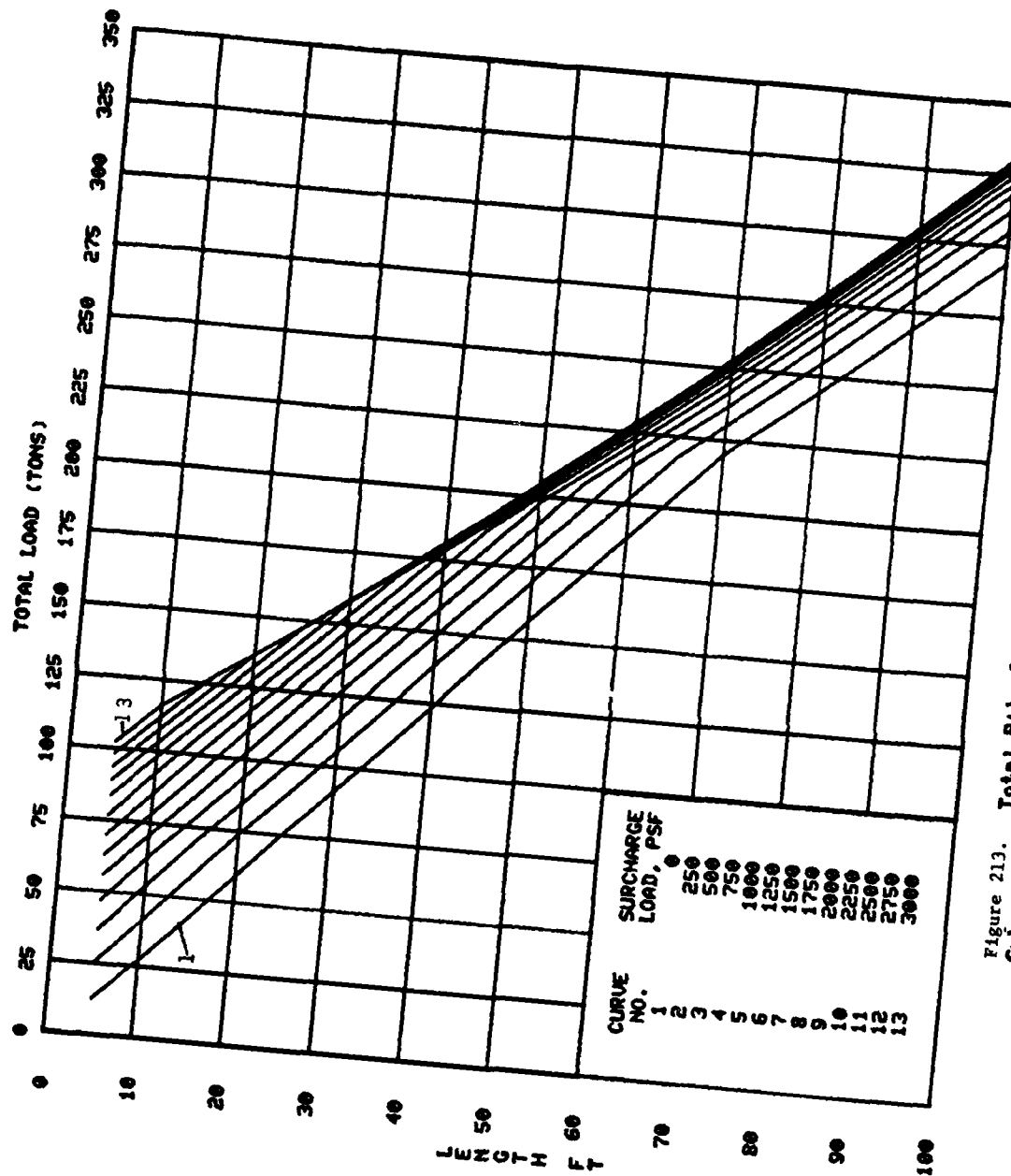


Figure 213. Total Pile Capacity For A 14-in Round Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\phi = 35^\circ$ ,  $C = 0$ .



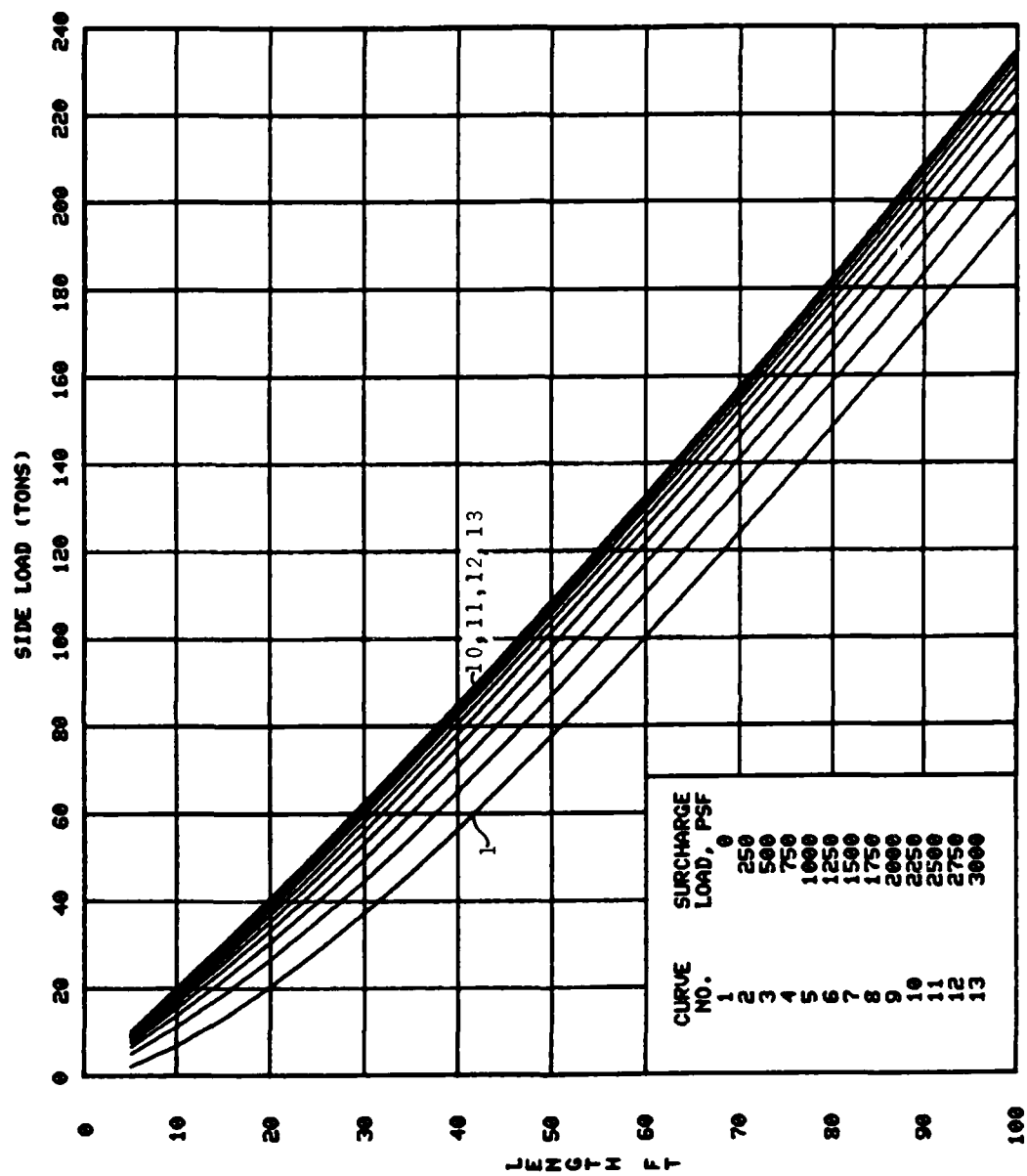


Figure 214. Side Capacity For A 14-in Round Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\phi=35$  Deg., C-0.



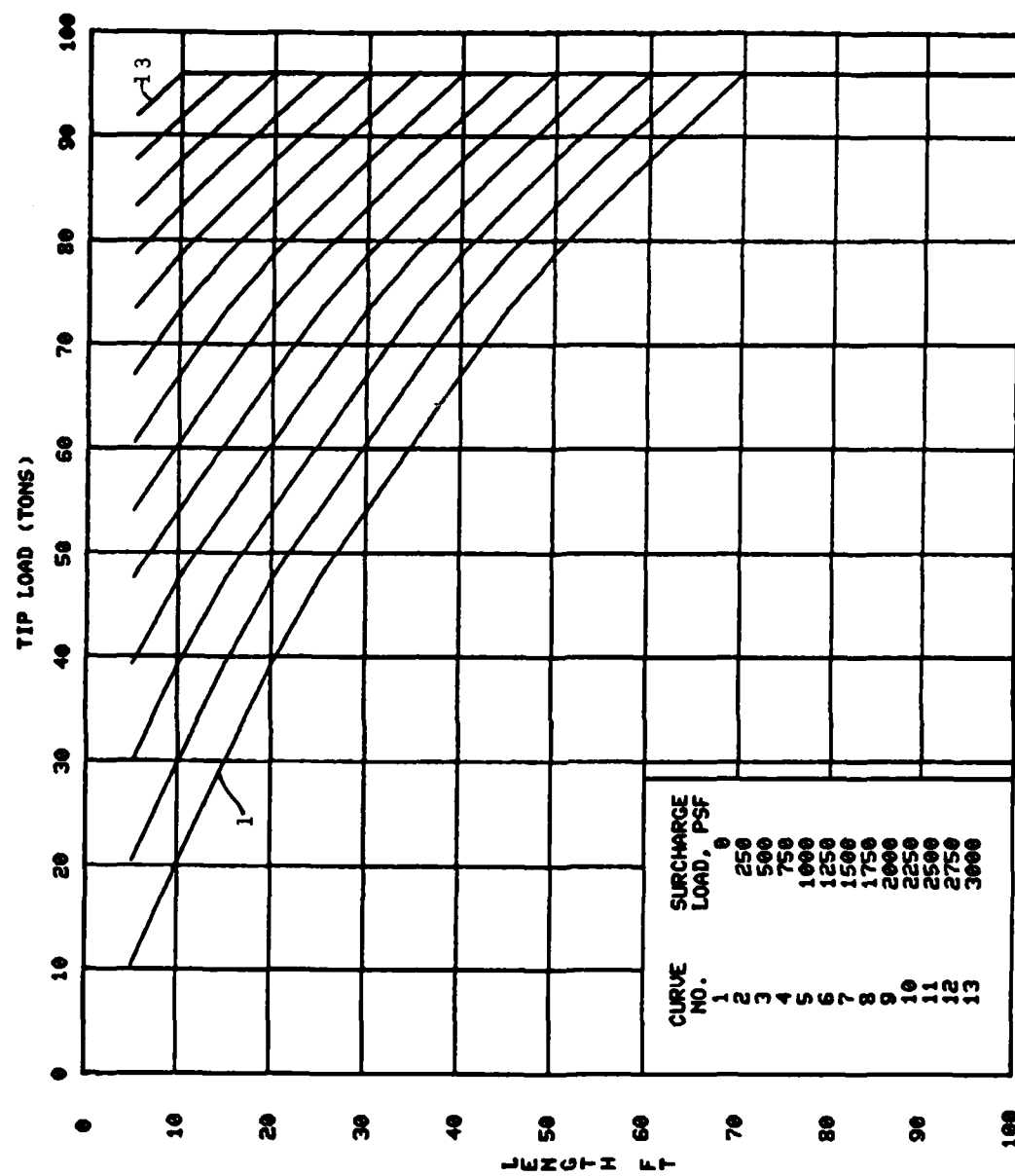


Figure 215. Tip Capacity For A 14-in Round Concrete Pile.  
Submerged Condition, 1/4-in. Tip Movement,  $\phi$ 1-35 Deg., C-0.



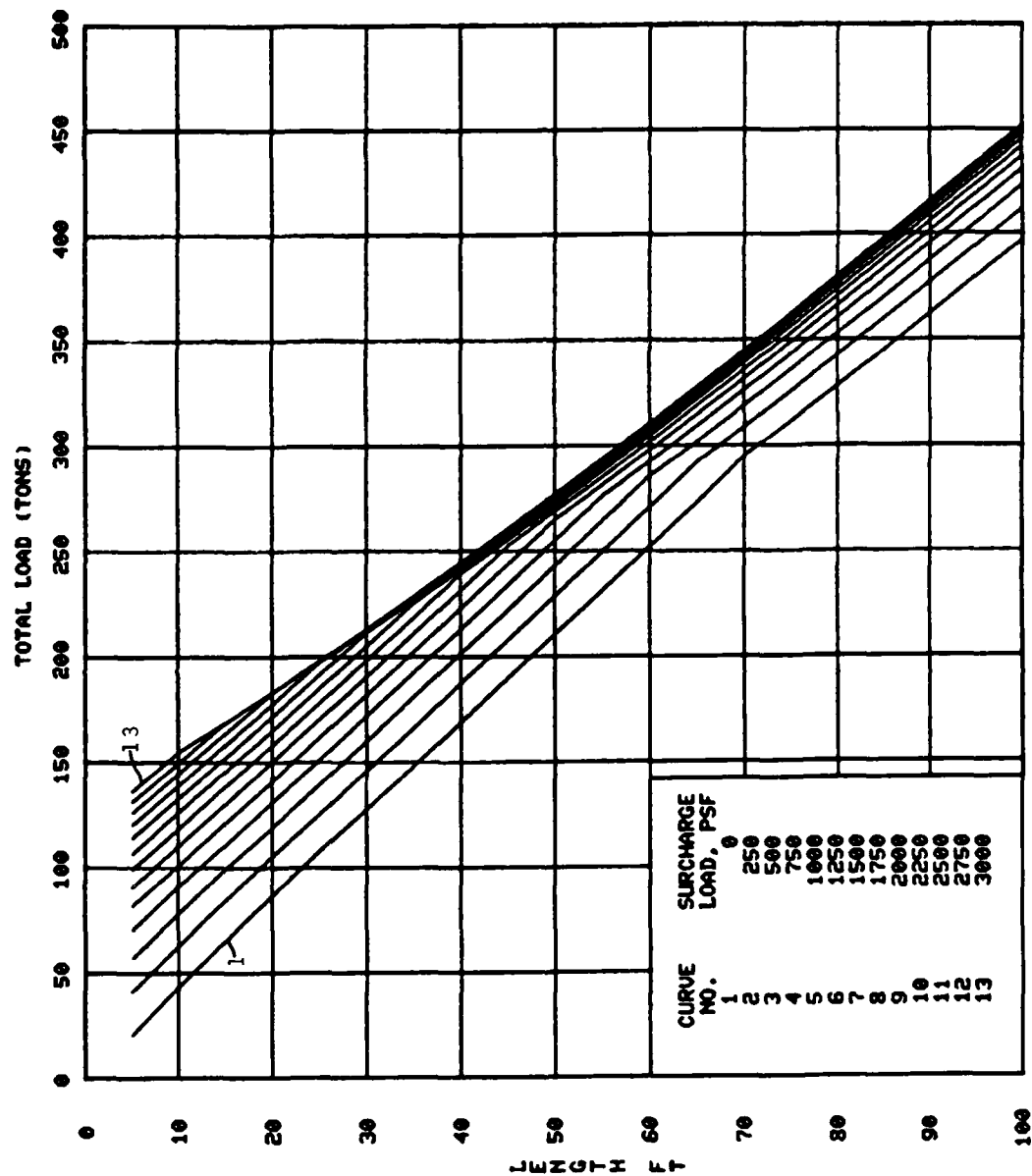


Figure 216. Total Pile Capacity For A 14-in Round Concrete Pile, Submerged Condition,  $1/4$ -in. Tip Movement,  $\Phi=37^\circ$ ,  $C=0$ .



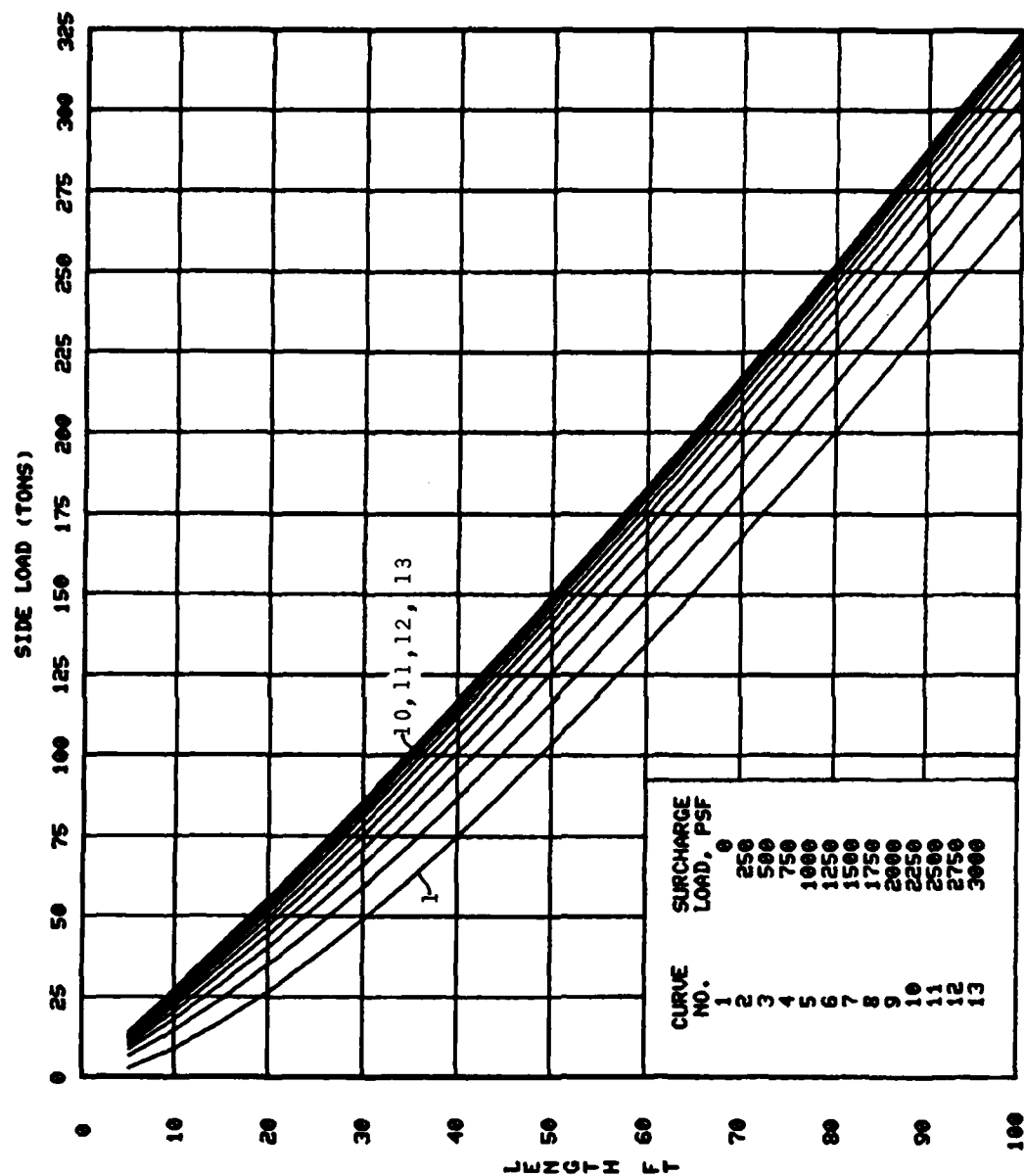


Figure 217. Side Capacity For A 14-in Round Concrete Pile. Submerged Condition, 1/4-in. Tip Movement,  $\Phi=37^\circ$ ,  $C=0$ .



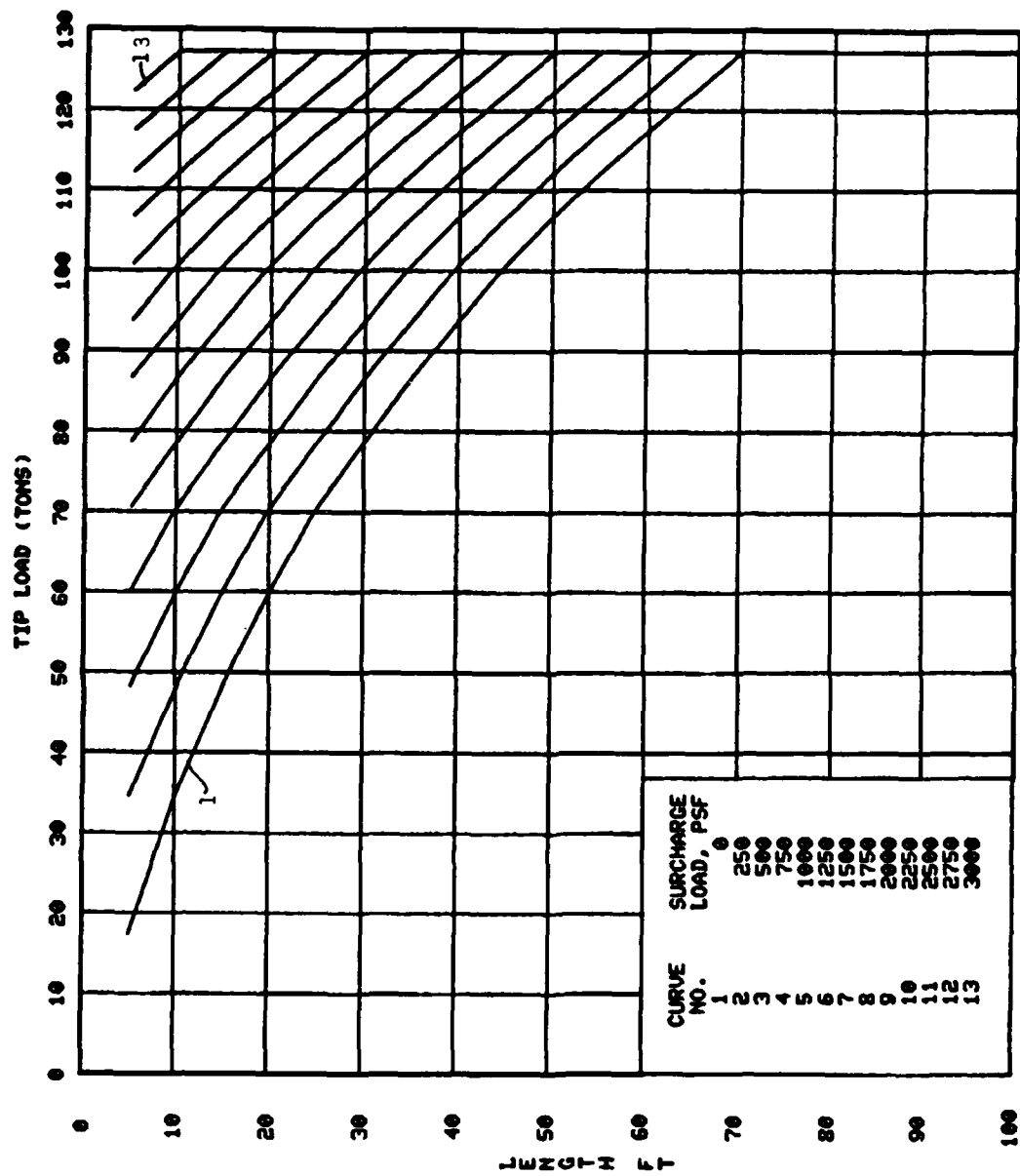


Figure 218. Tip Capacity For A 14-in Round Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi_{1-37}$  Deg., C-0.



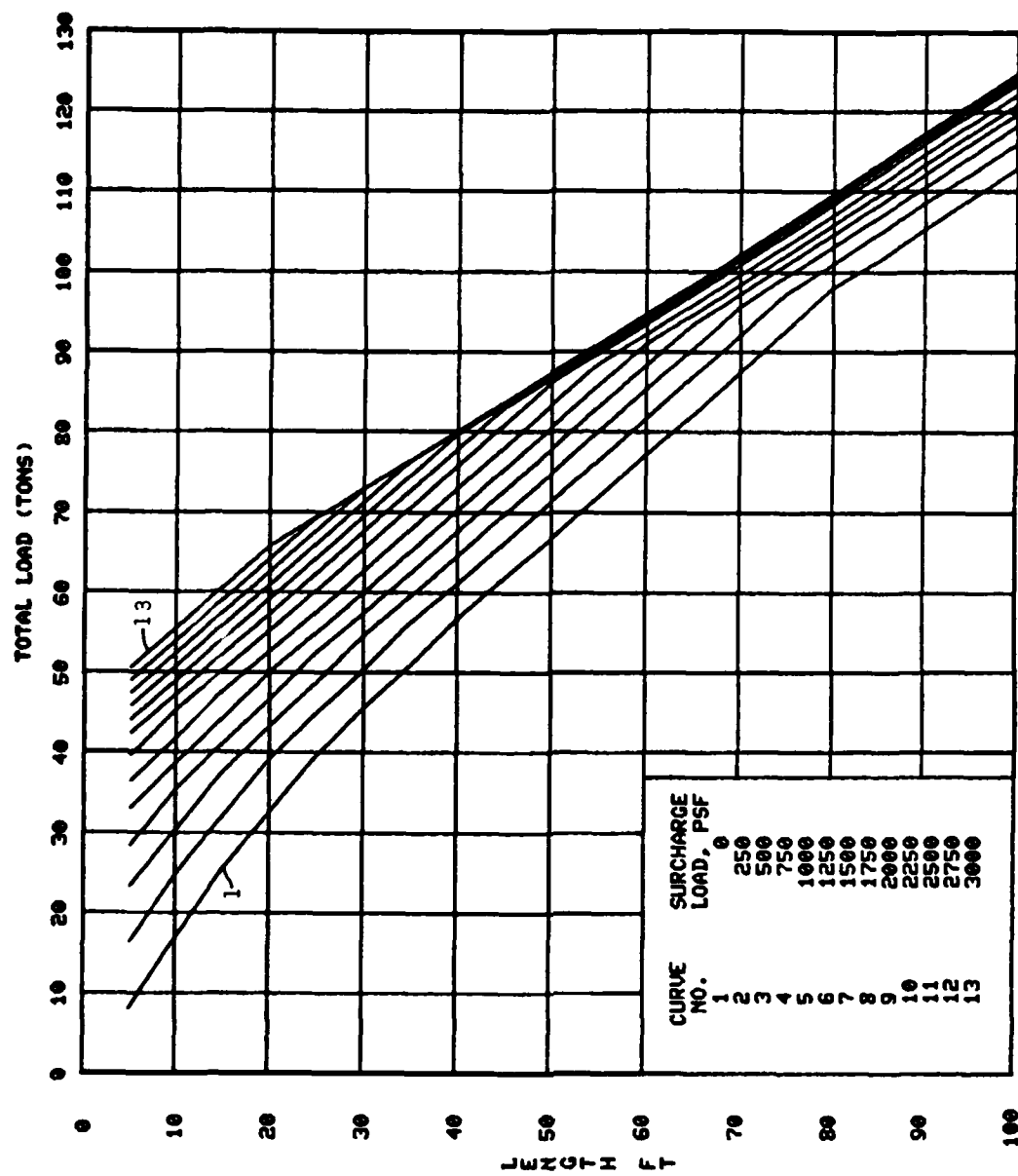


Figure 219. Total Pile Capacity For A 16-in Round Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi$ 1-36 Deg., C-9.



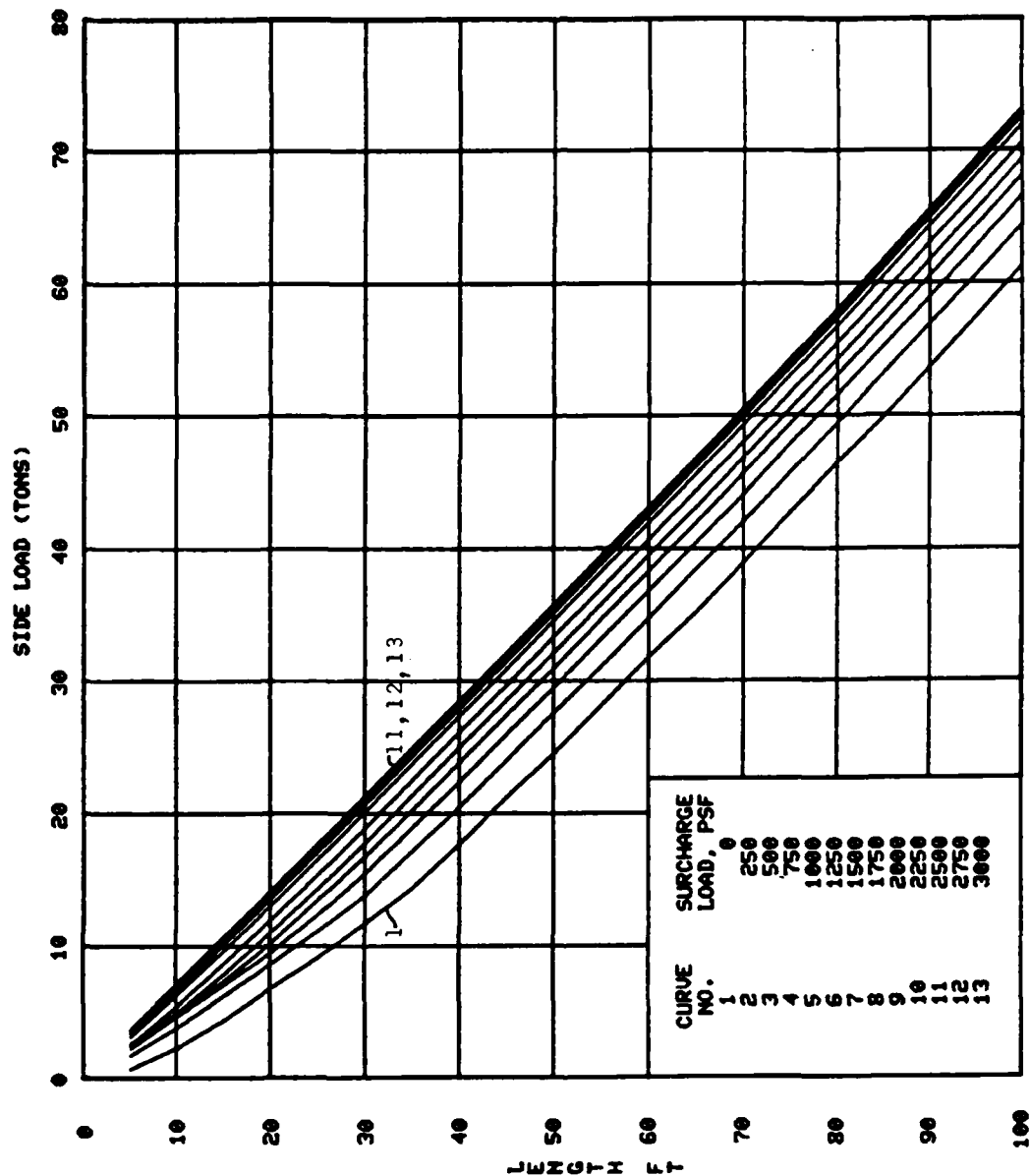


Figure 220. Side Capacity For A 16-in Round Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\phi=30$  Deg., C-0.



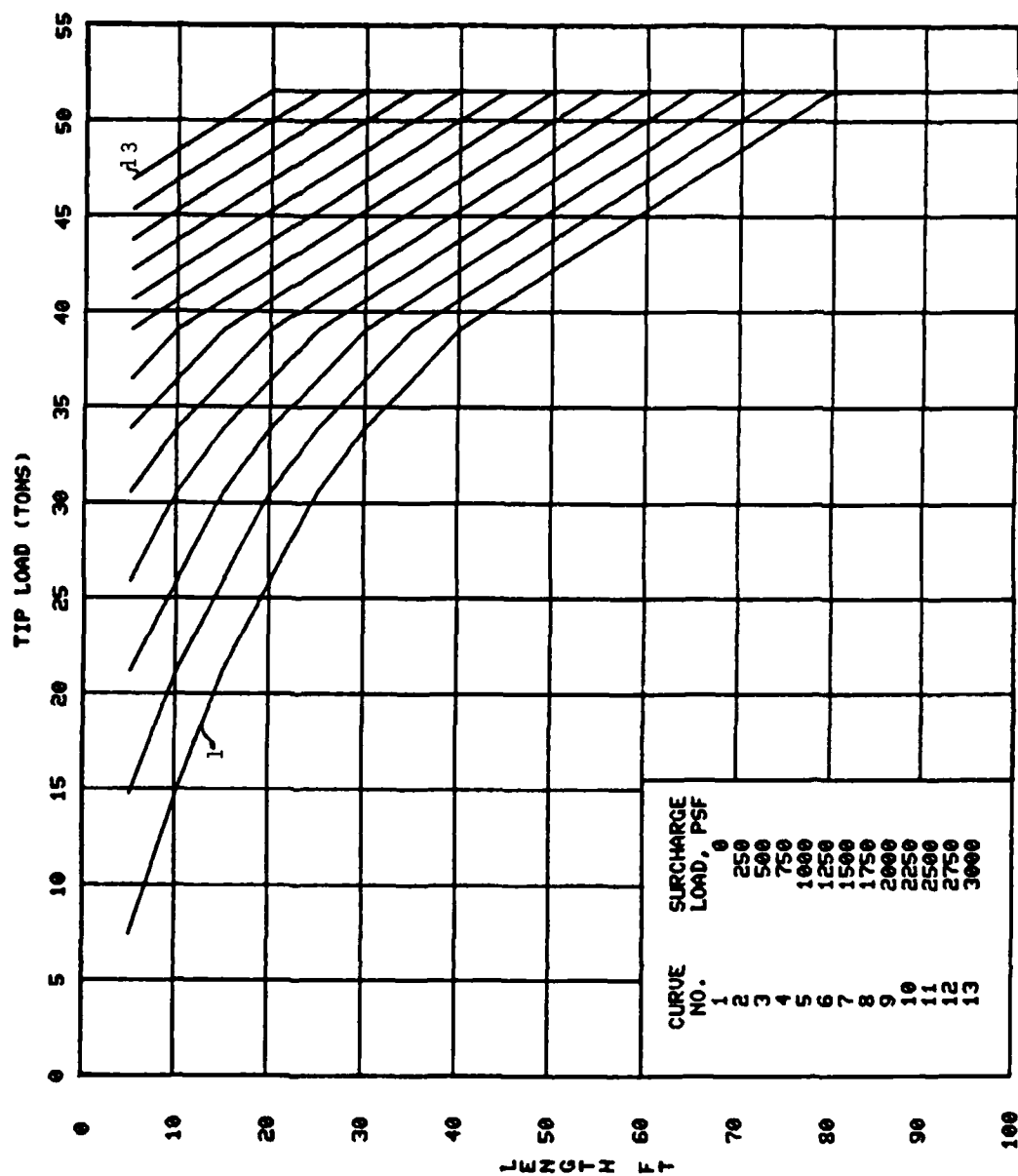


Figure 221. Tip Capacity For A 16-in Round Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi=30$  Deg., C-0.



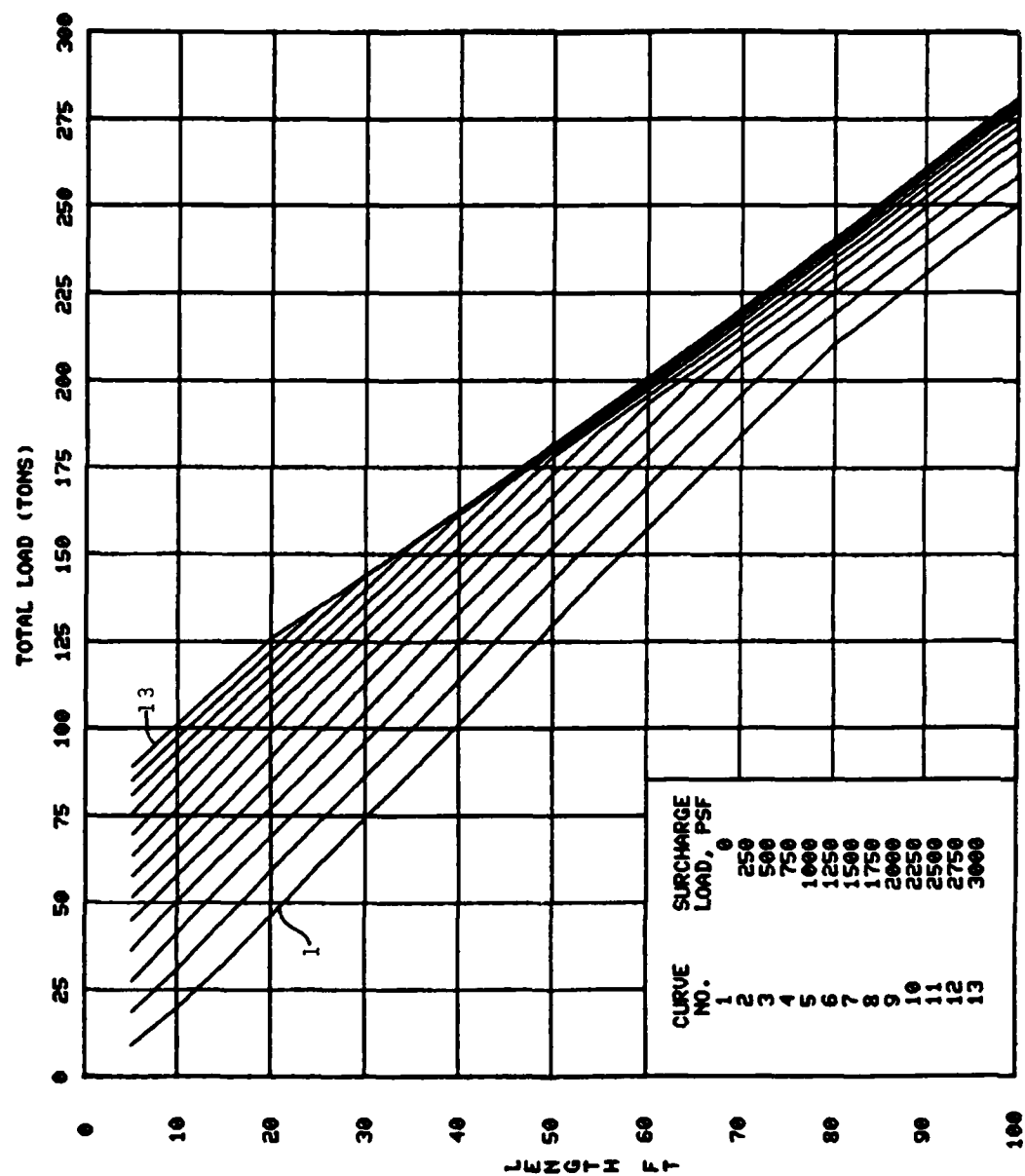


Figure 222. Total Pile Capacity For A 16-in Round Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\phi=33$  Deg., C-0.



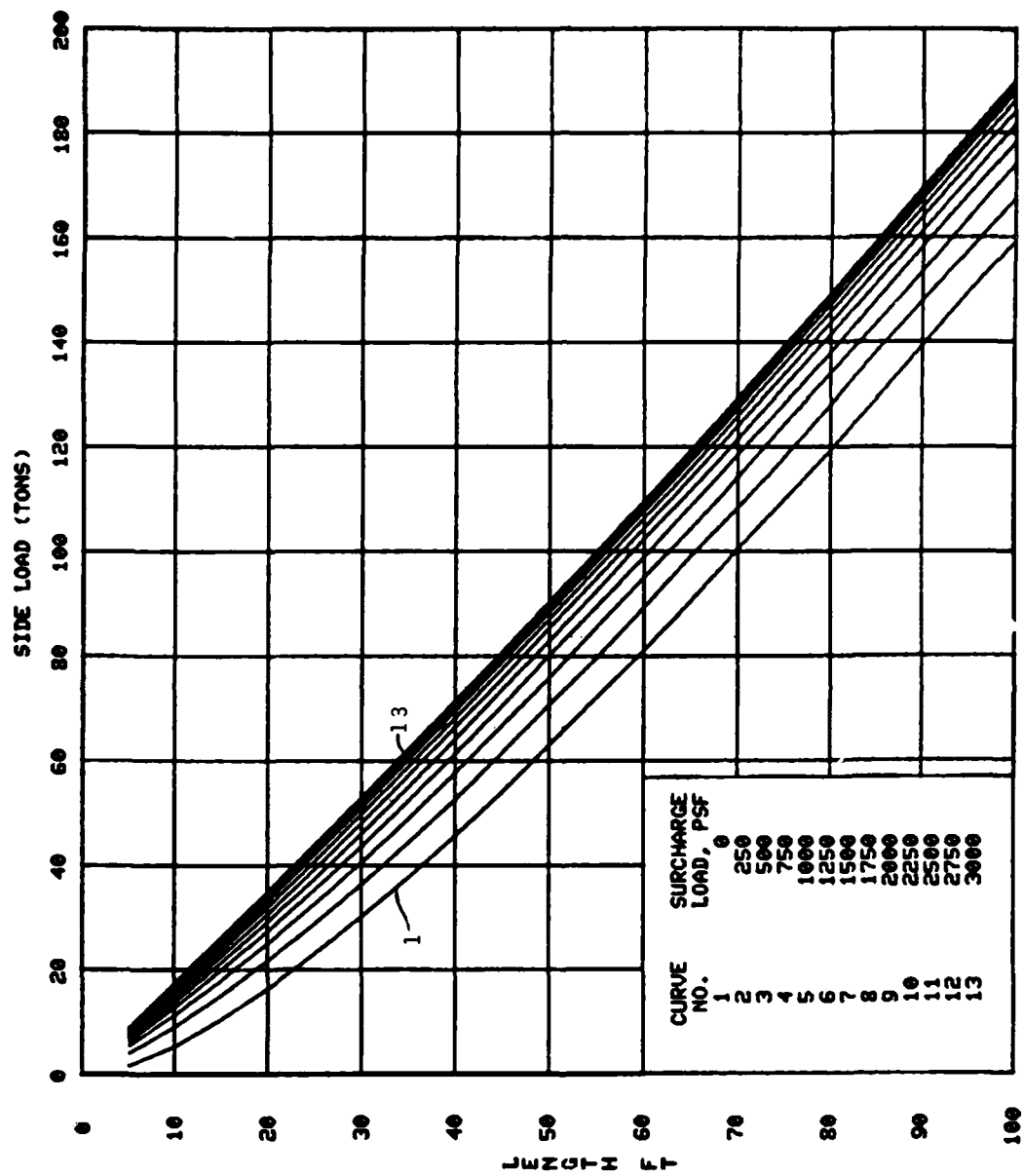


Figure 223. Side Capacity For A 16-in Round Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi$ 1-33 Deg., C-0.



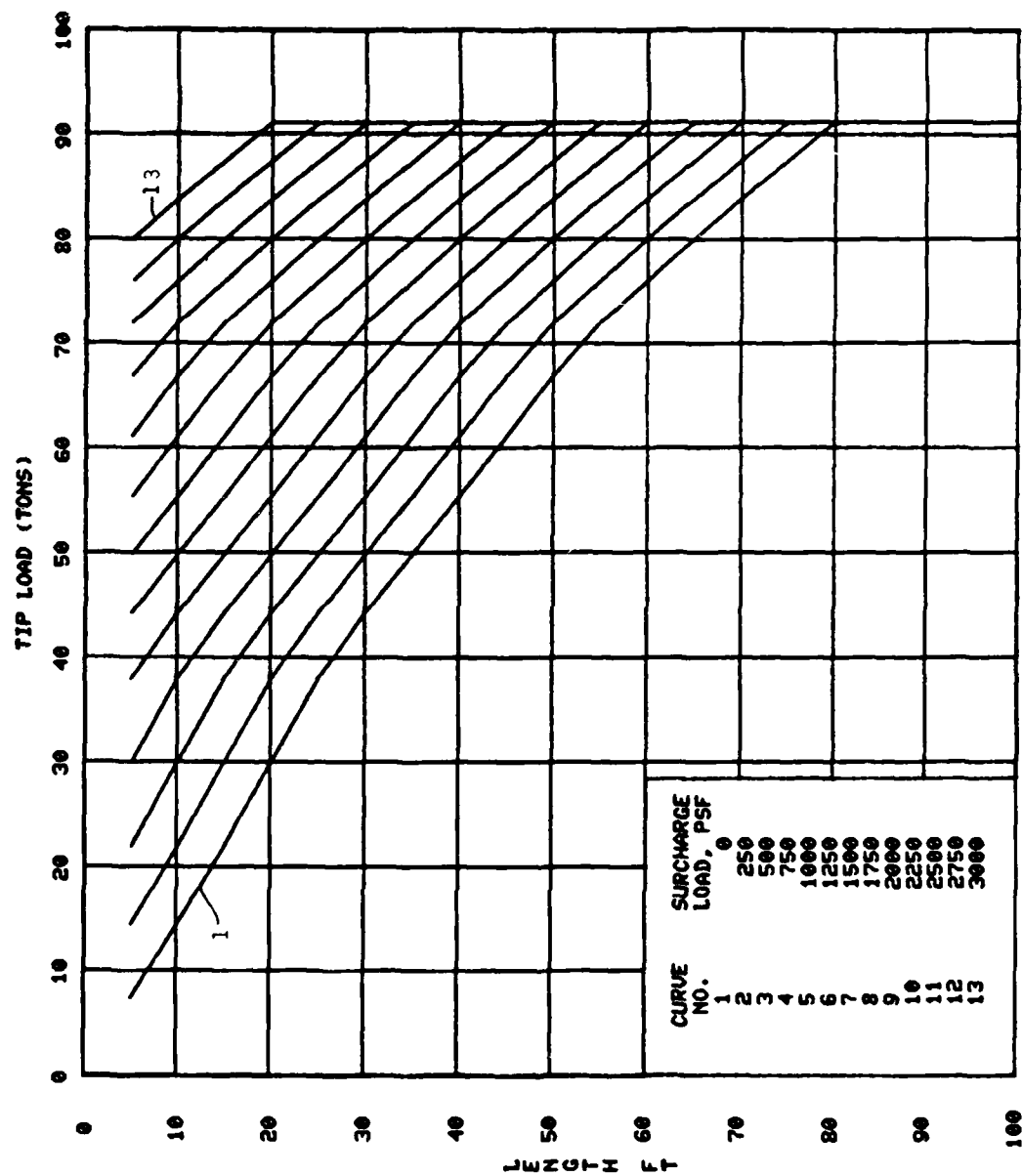


Figure 224. Tip Capacity For A 16-in Round Concrete Pile,  
Submerged Condition, 1/4-in. Tip Movement,  $\Phi=33^\circ$  Deg., C-0.



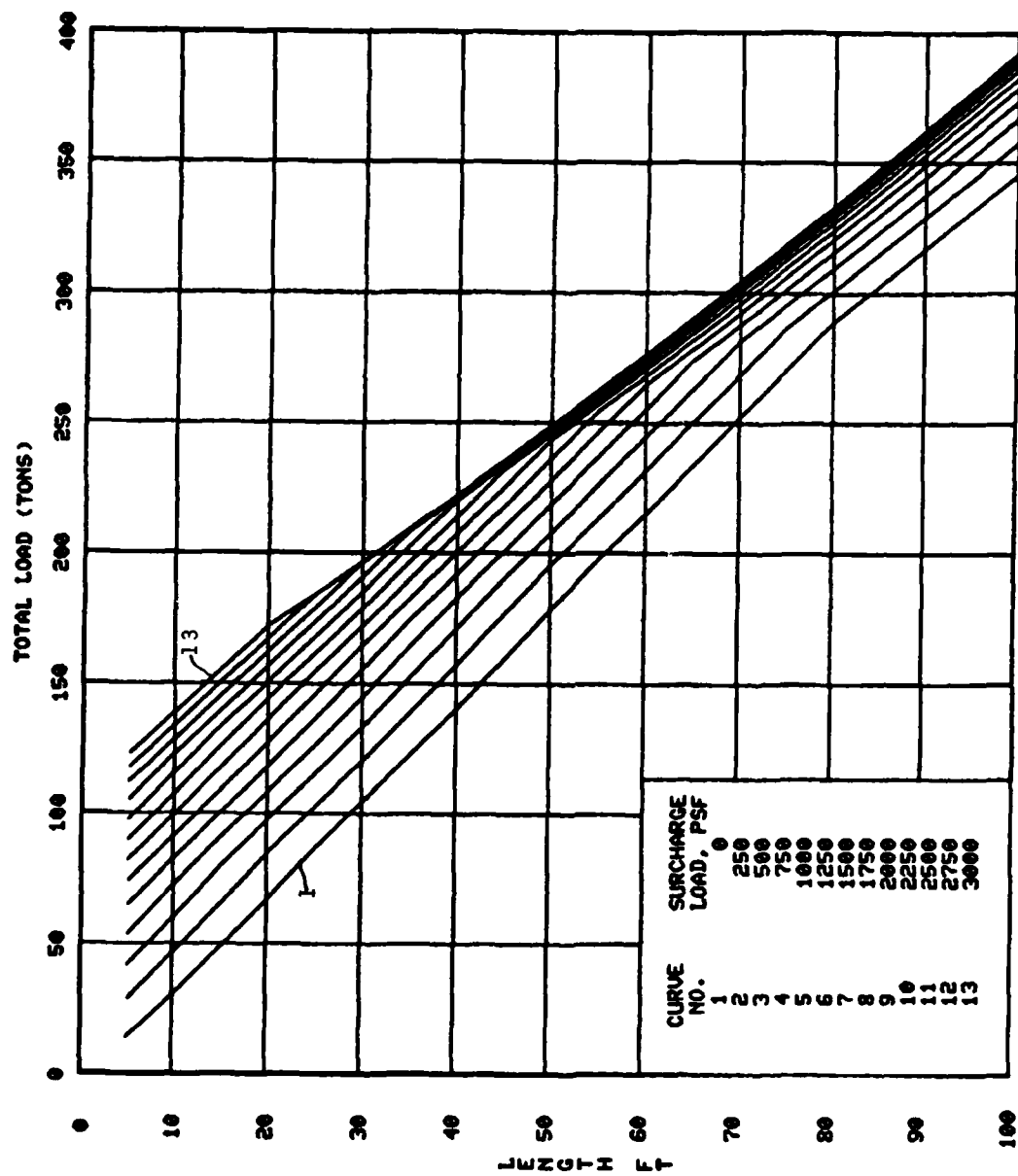


Figure 225. Total Pile Capacity For A 16-in Round Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\phi=35$  Deg., C-0.



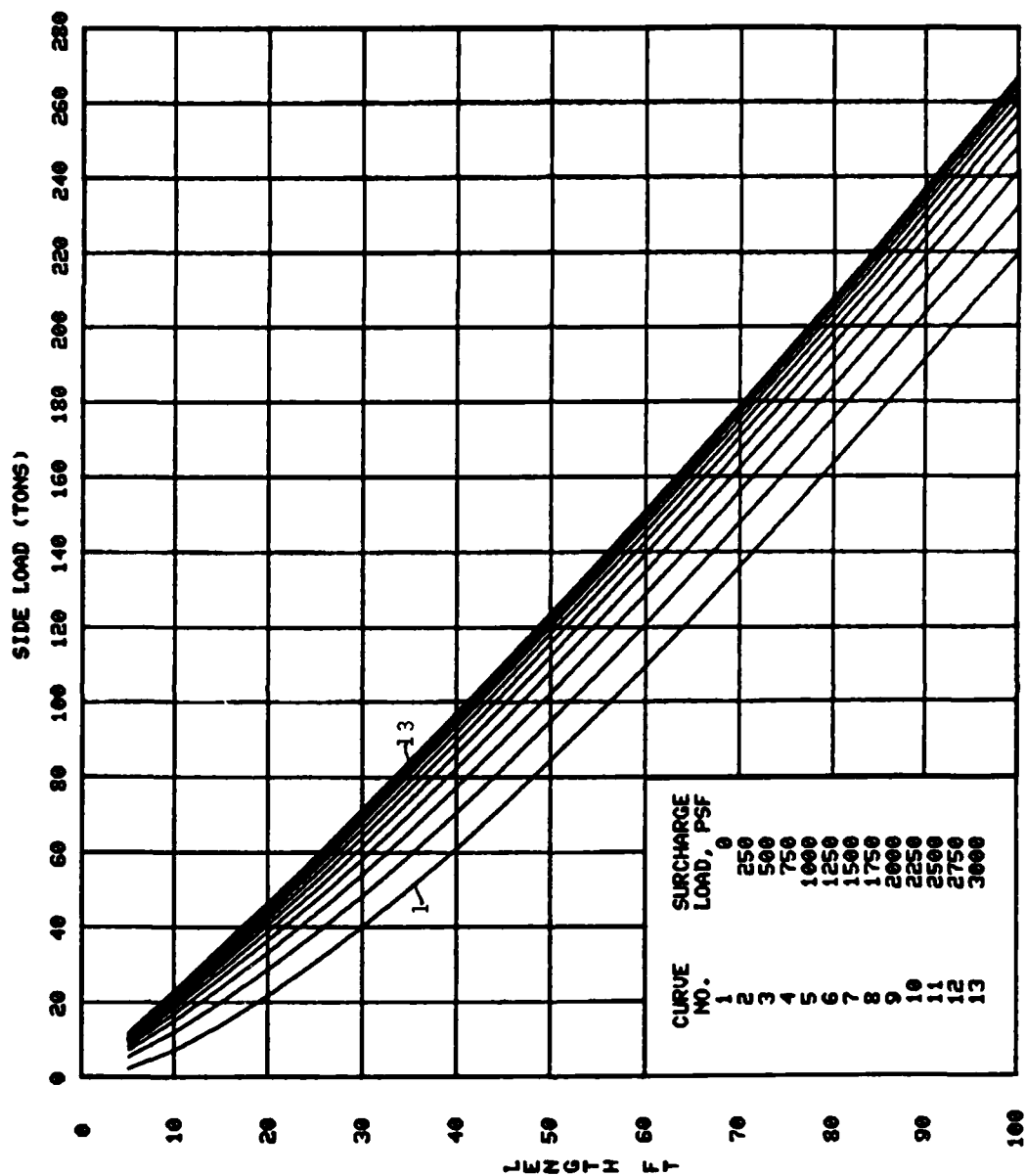


Figure 226. Side Capacity For A 16-in Round Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi$ 1-35 Deg., C-0.



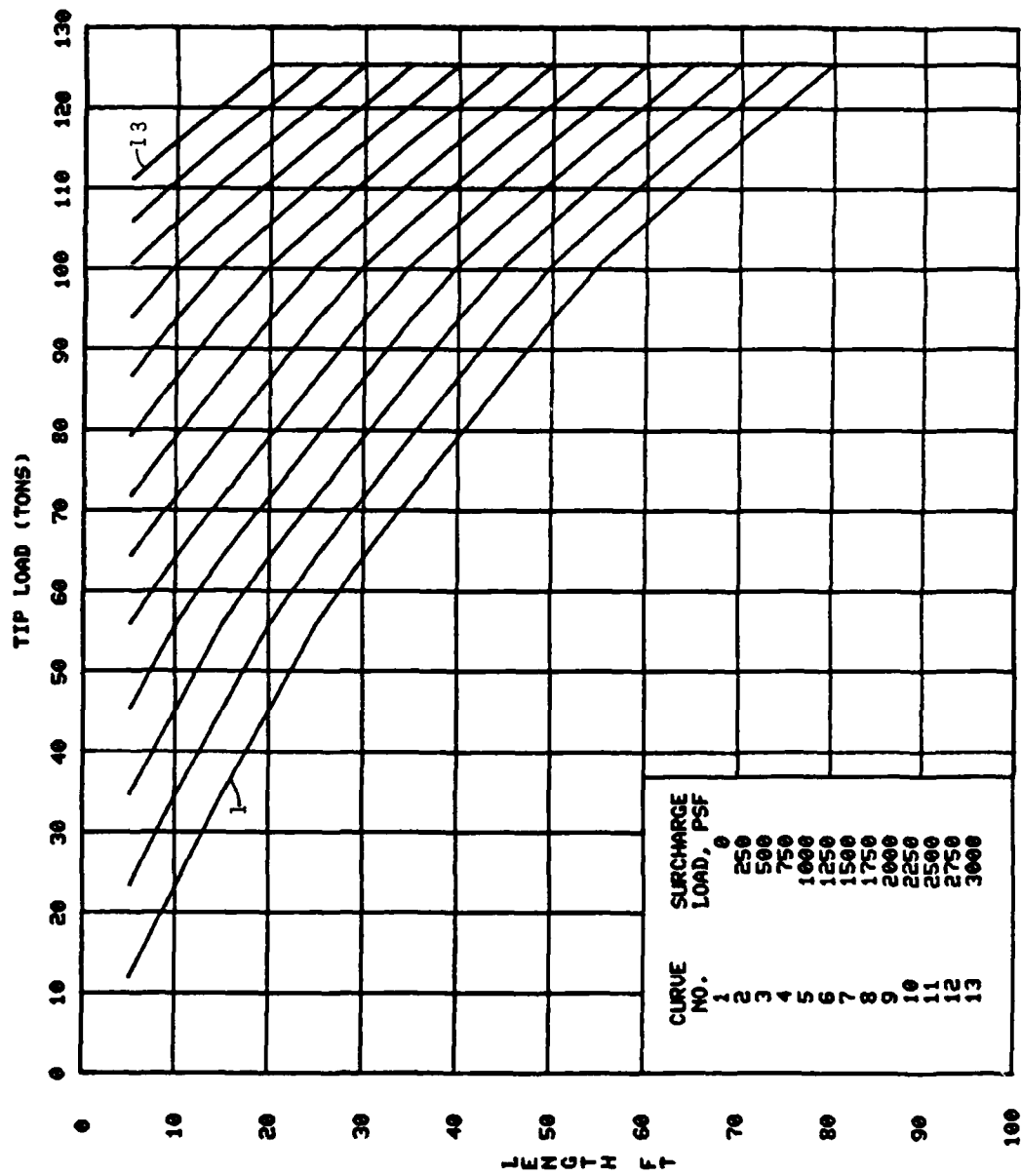


Figure 227. Tip Capacity For A 16-in Round Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi=35^\circ$ , C-0.



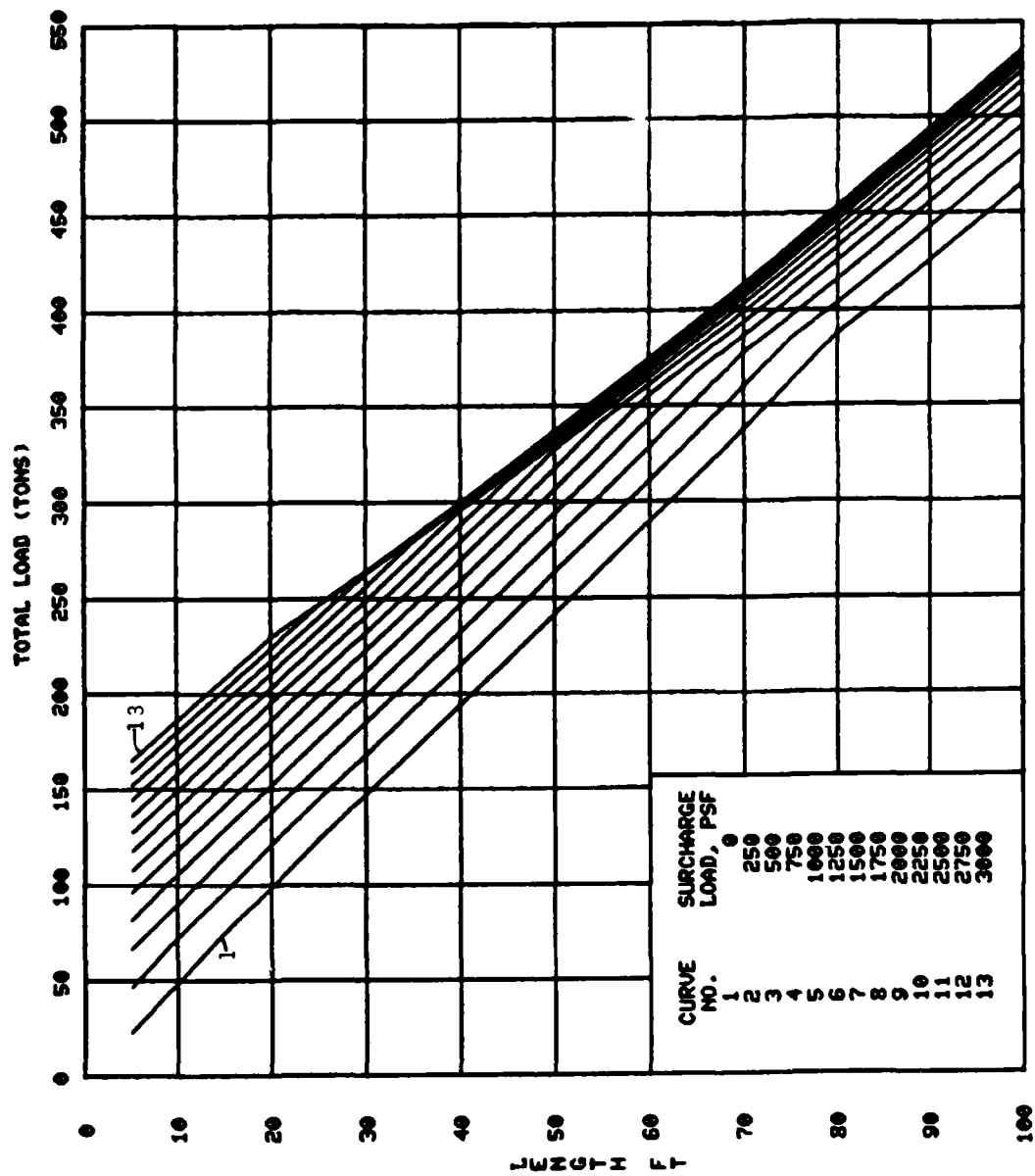


Figure 228. Total Pile Capacity For A 16-in Round Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi=37$  Deg., C-0.



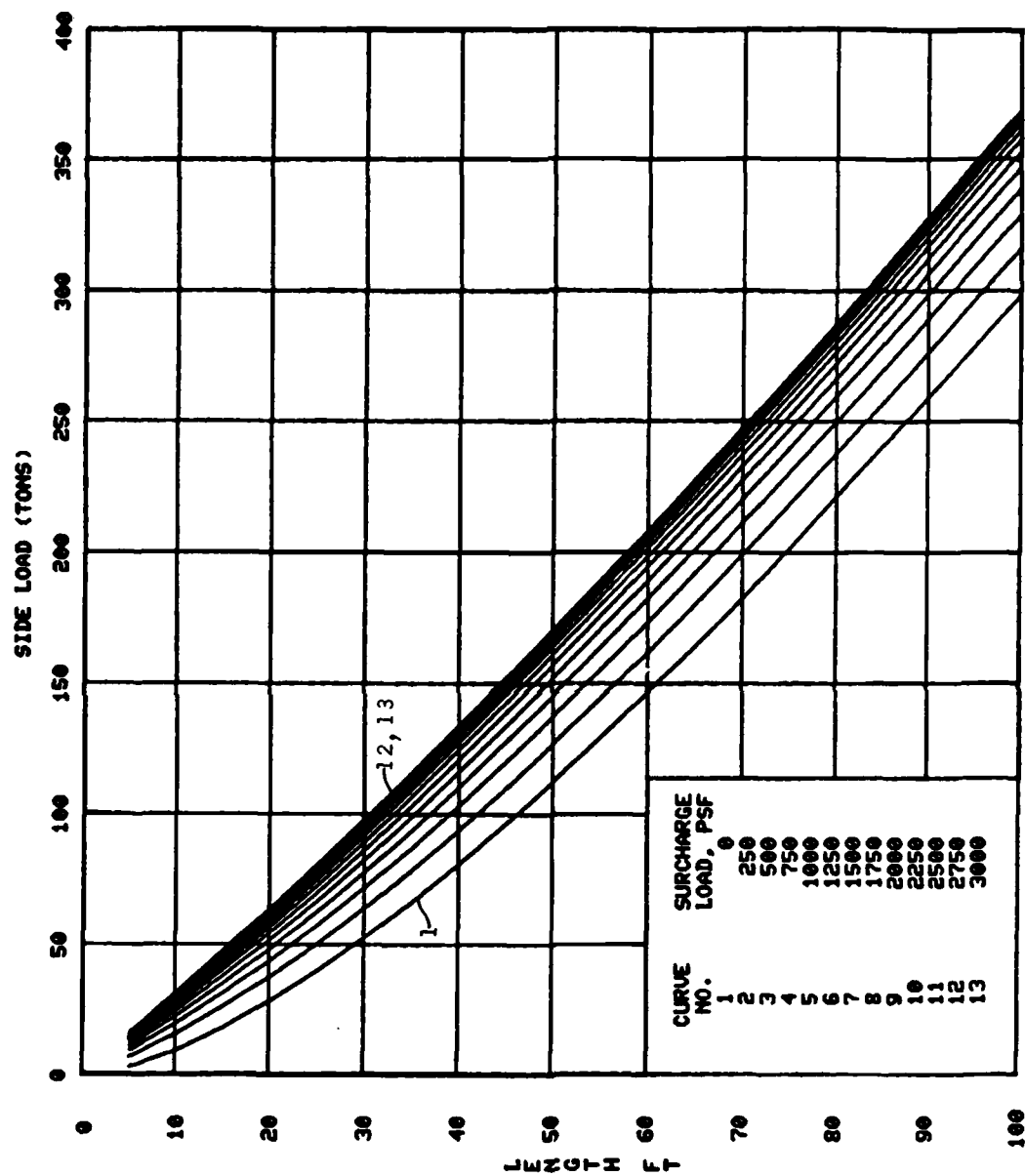


Figure 229. Side Capacity For A 16-in Round Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\phi=37$  Deg., C-0.



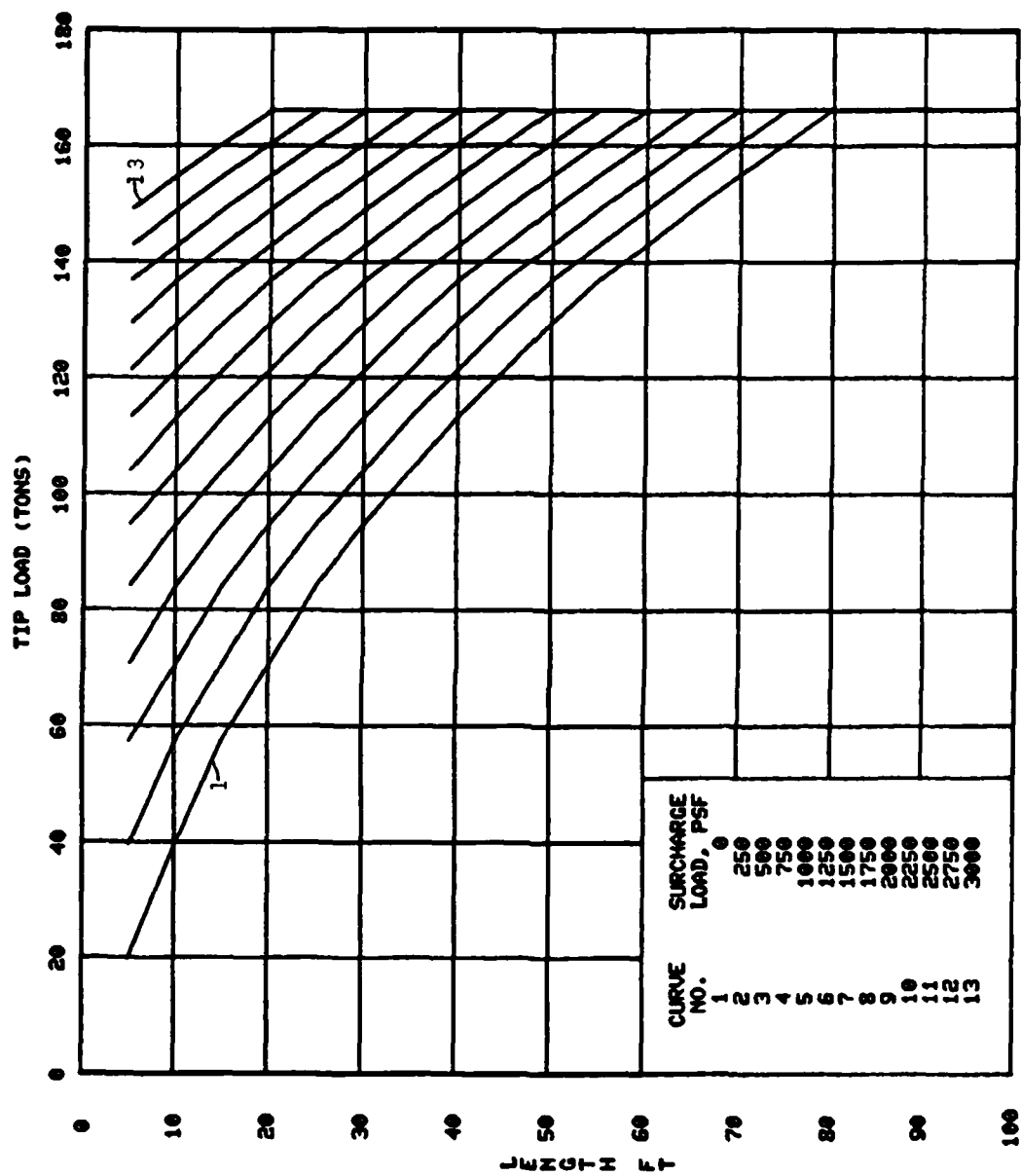


Figure 230. Tip Capacity For A 16-in Round Concrete Pile, Submerged Condition, 1/4-in. Tip Movement,  $\Phi$ 1-37 Deg., C-0.



CHAPTER 6: LOAD CAPACITY CURVES FOR  
COMPOSITE STEEL, CONCRETE PILES

Total pile, side, and pit capacity curves for composite steel, concrete piles are presented as follows:

<u>Curves for</u>	<u>Shown in Figure</u>
10 Inches	231-242
12 Inches	243-254
14 Inches	255-266
16 Inches	267-278



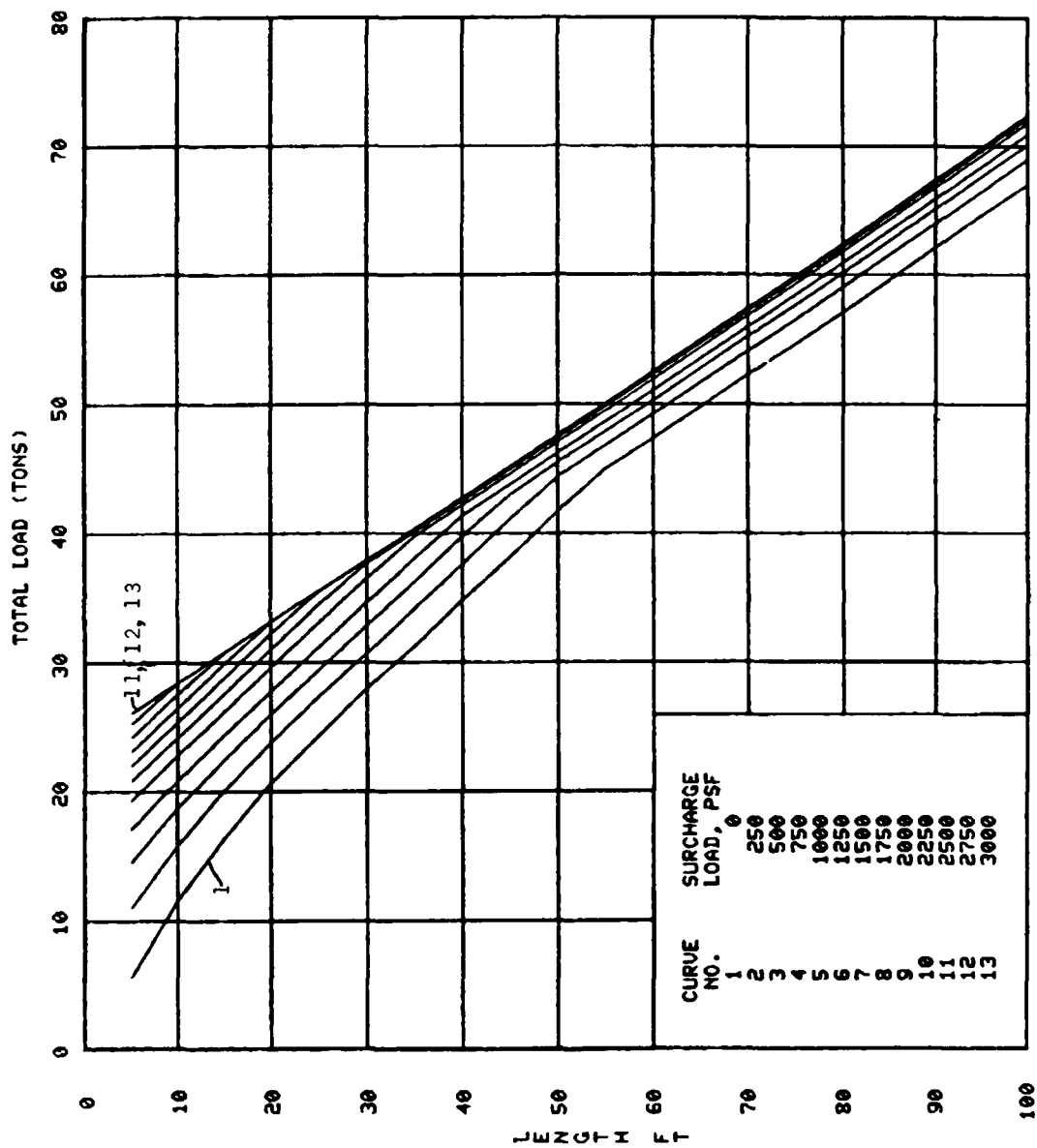


Figure 231. Total Pile Capacity For A 10-in Concrete Filled Pipe Pile  
Submerged Condition, 1/4-in. Tip Movement,  $\Phi=30$  Deg.,  $C=0$



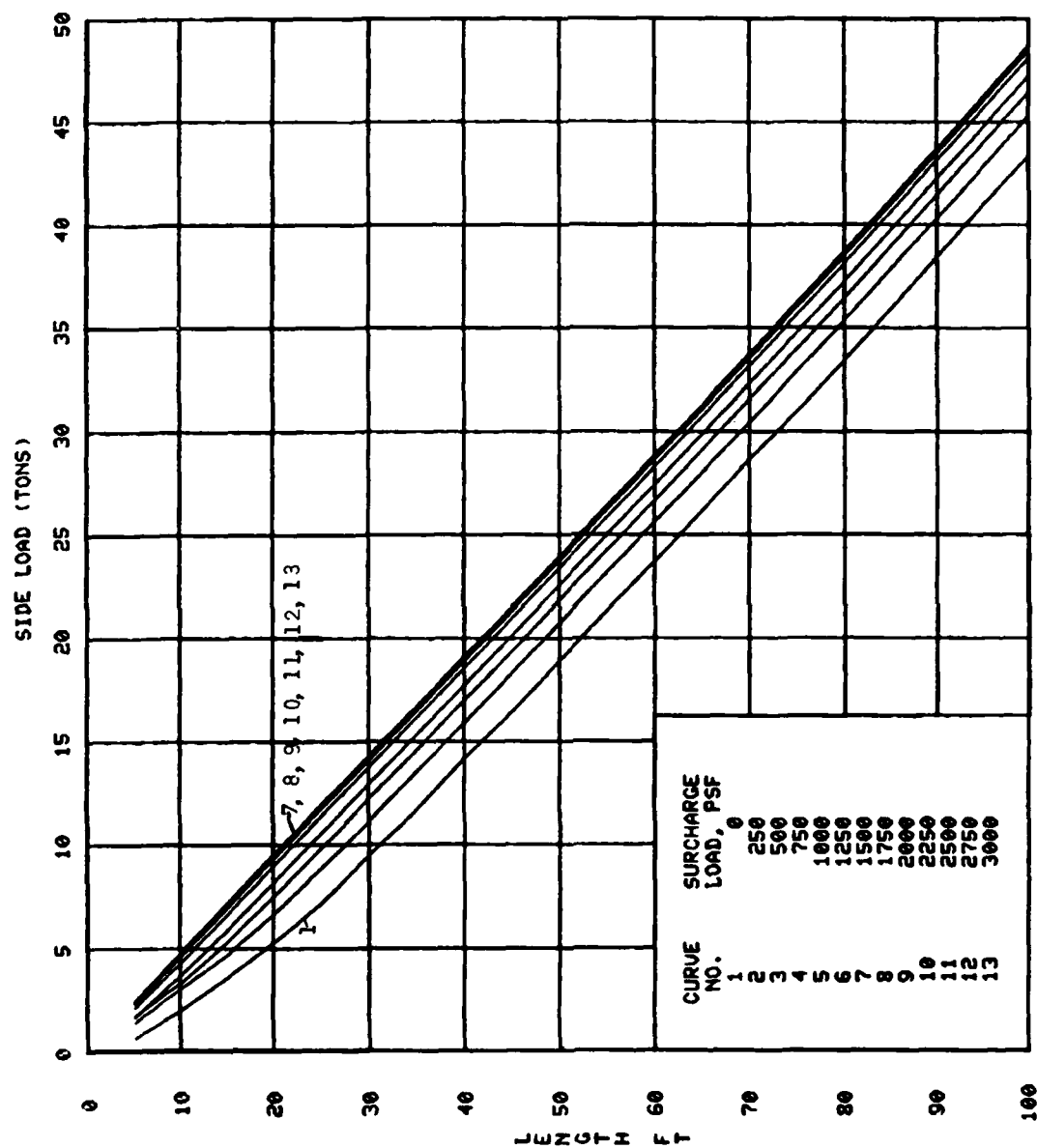


Figure 232. Side Capacity For A 10-in Concrete Filled Pipe Pile  
Submerged Condition, 1/4-in. Tip Movement,  $\Phi=30$  Deg.,  $C=0$



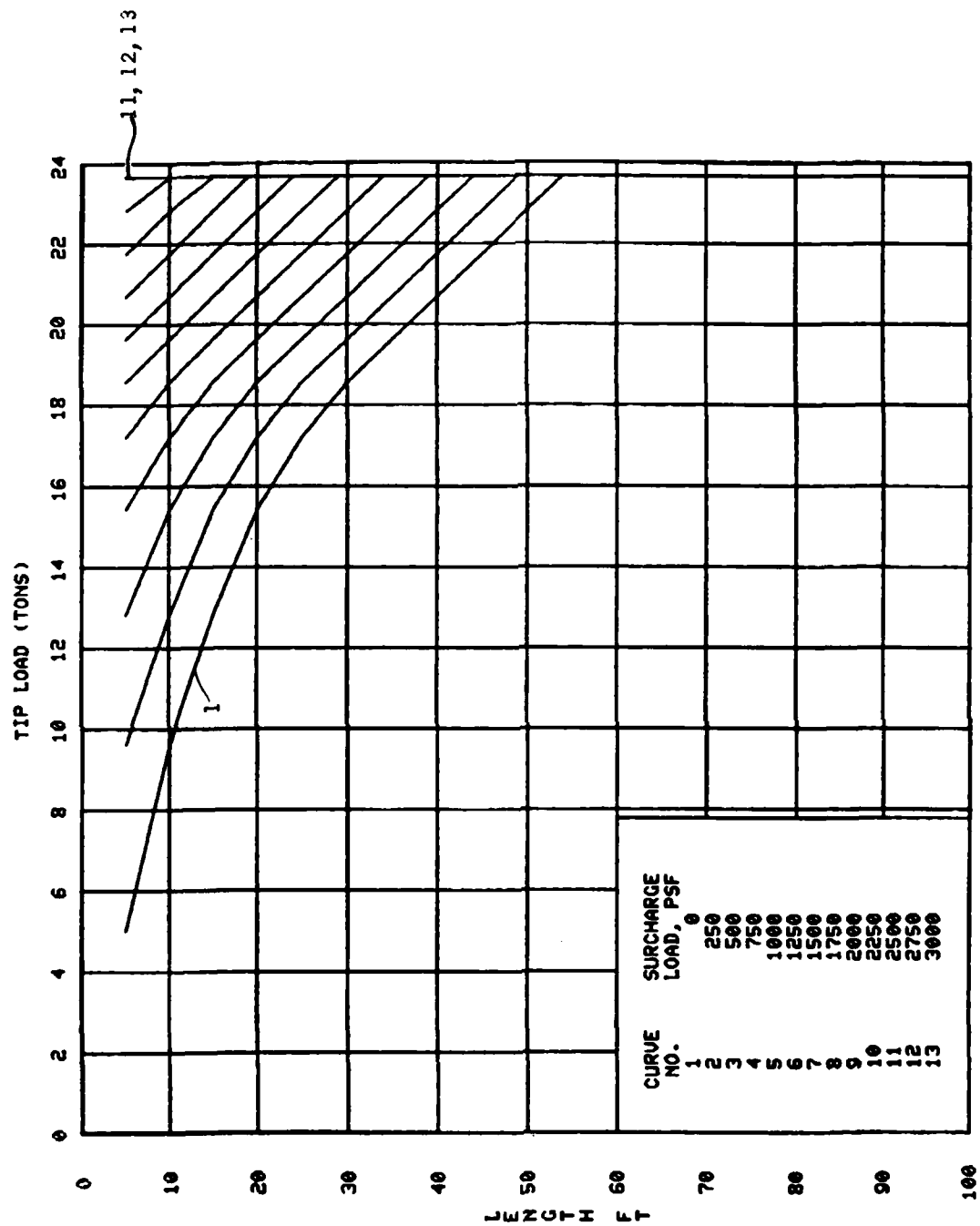


Figure 233. Tip Capacity For A 10-in Concrete Filled Pipe Pile  
Submerged Condition, 1/4-in. Tip Movement,  $\Phi=30$  Deg., C-0



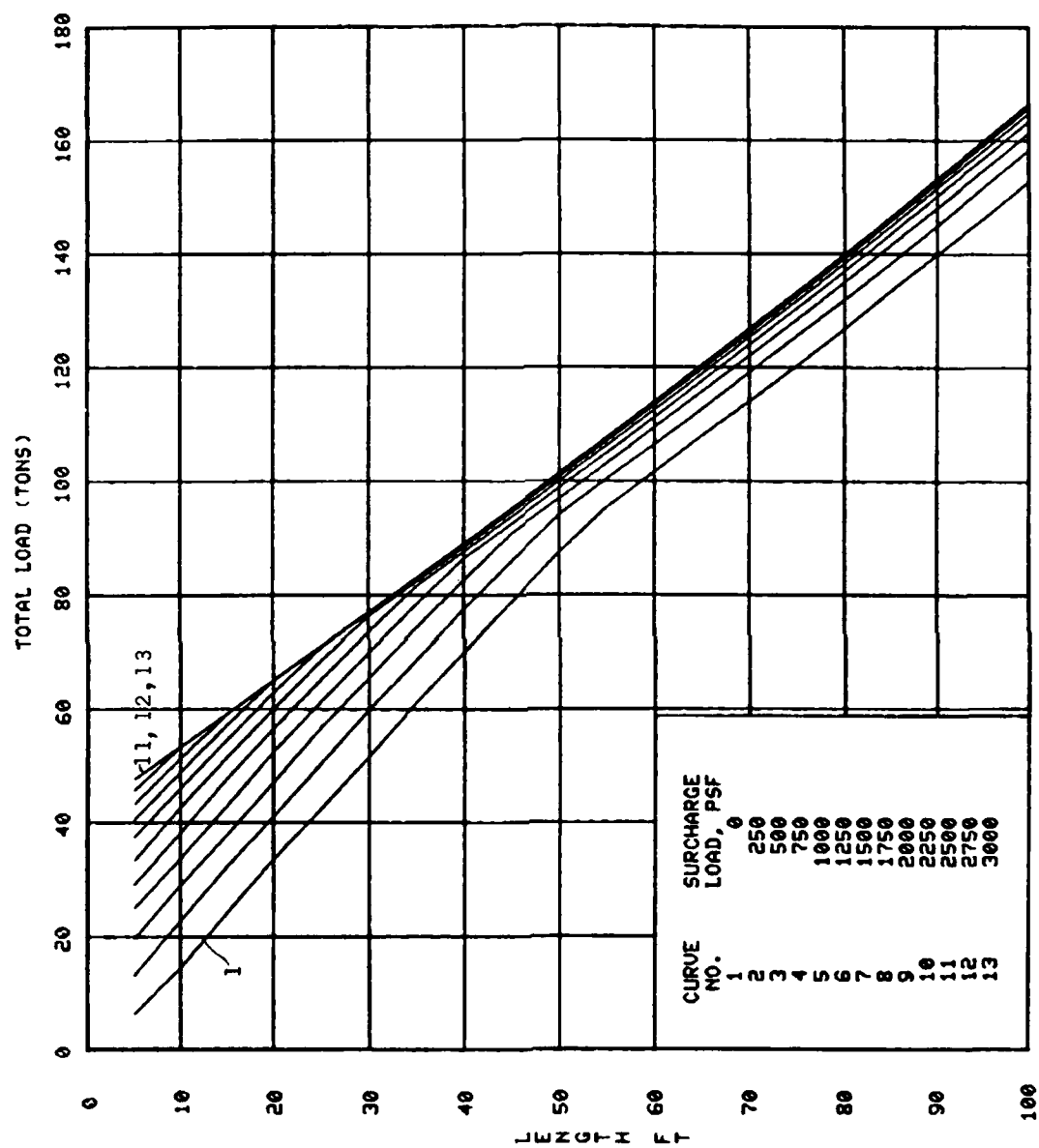


Figure 234. Total Pile Capacity For A 10-in Concrete Filled Pipe Pile Submerged Condition, 1/4-in. Tip Movement,  $\Phi=33^\circ$  Deg.,  $C=0$ .



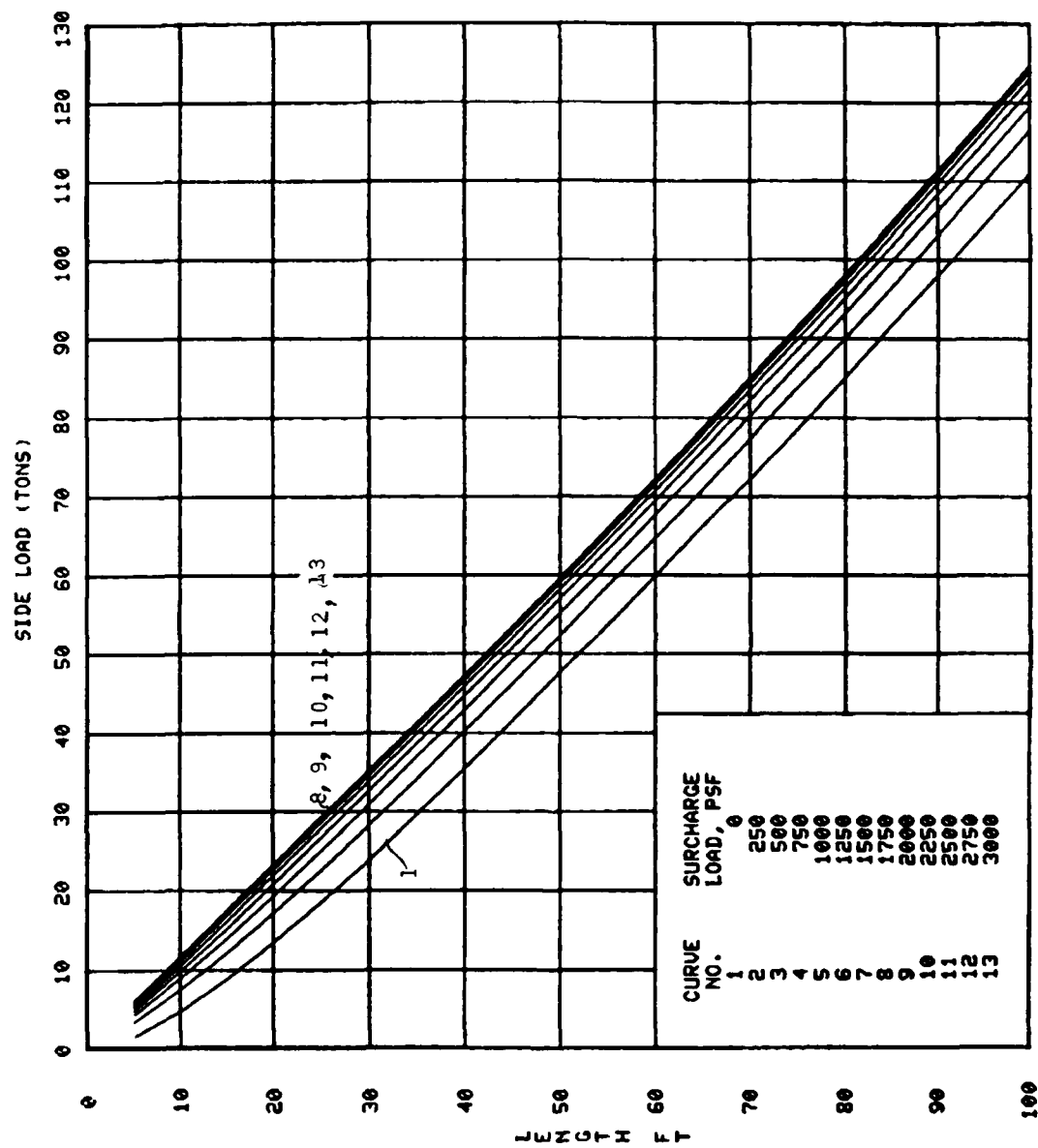


Figure 235. Side Capacity For A 10-in Concrete Filled Pipe Pile Submerged Condition, 1/4-in. Tip Movement, Phi-33 Deg., C-0.



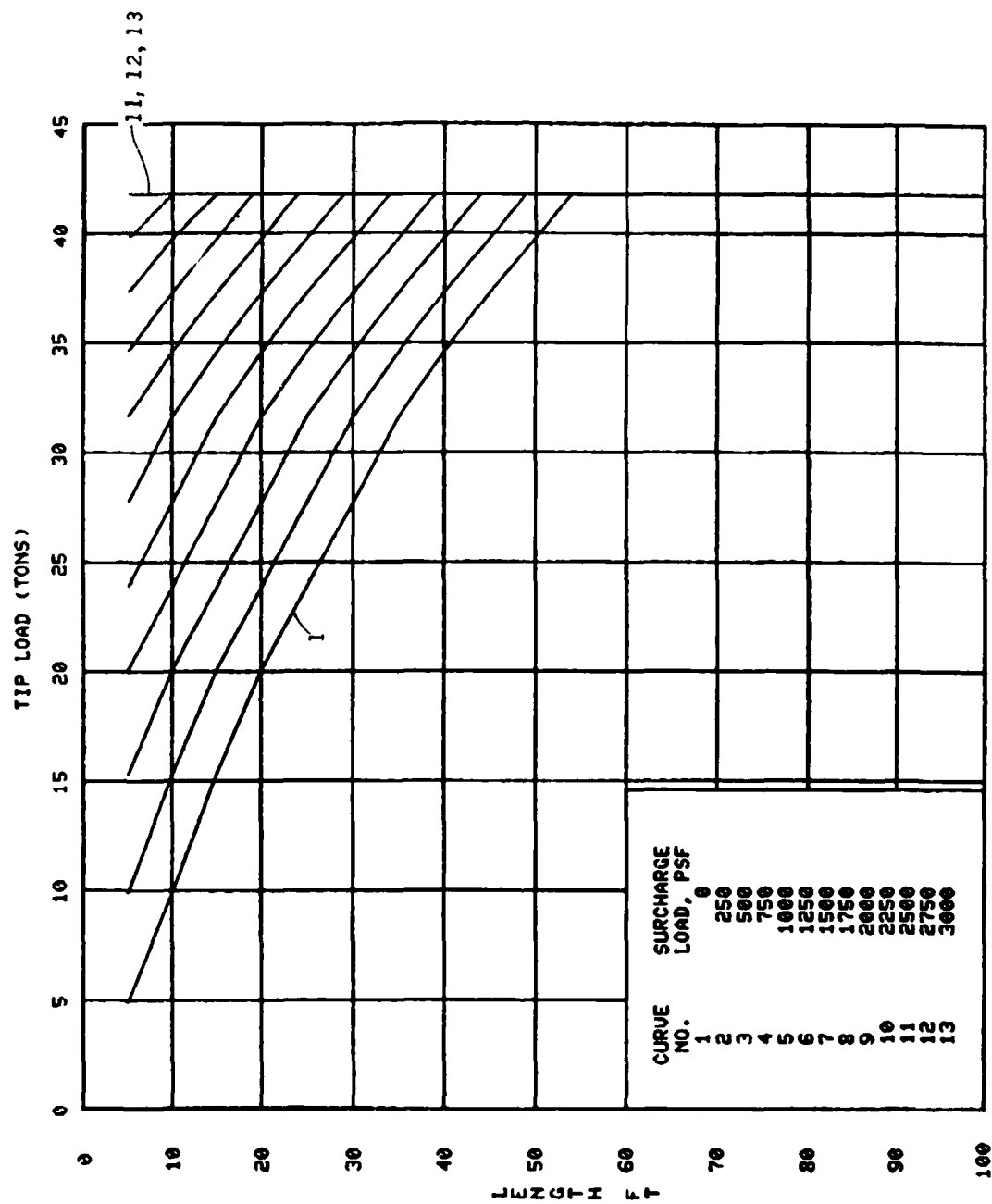


Figure 236. Tip Capacity For A 10-in Concrete Filled Pipe Pile Submerged Condition,  $1\frac{1}{4}$ -in. Tip Movement,  $\Phi=33$  Deg.,  $C=0$ .



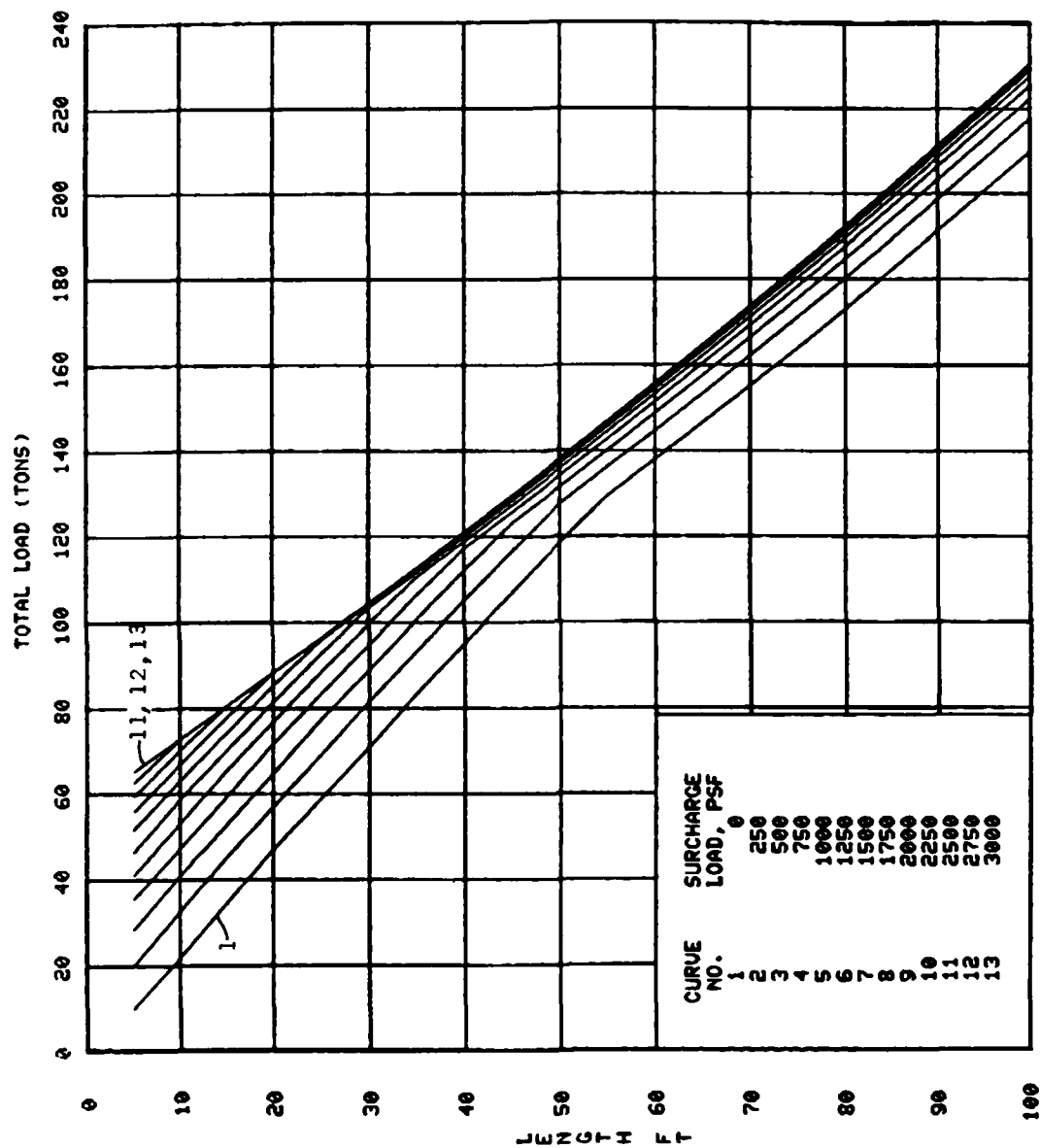


Figure 237. Total Pile Capacity For A 10-in Concrete Filled Pipe Pile Submerged Condition, 1/4-in. Tip Movement,  $\Phi=35^\circ$ ,  $C=0$ .



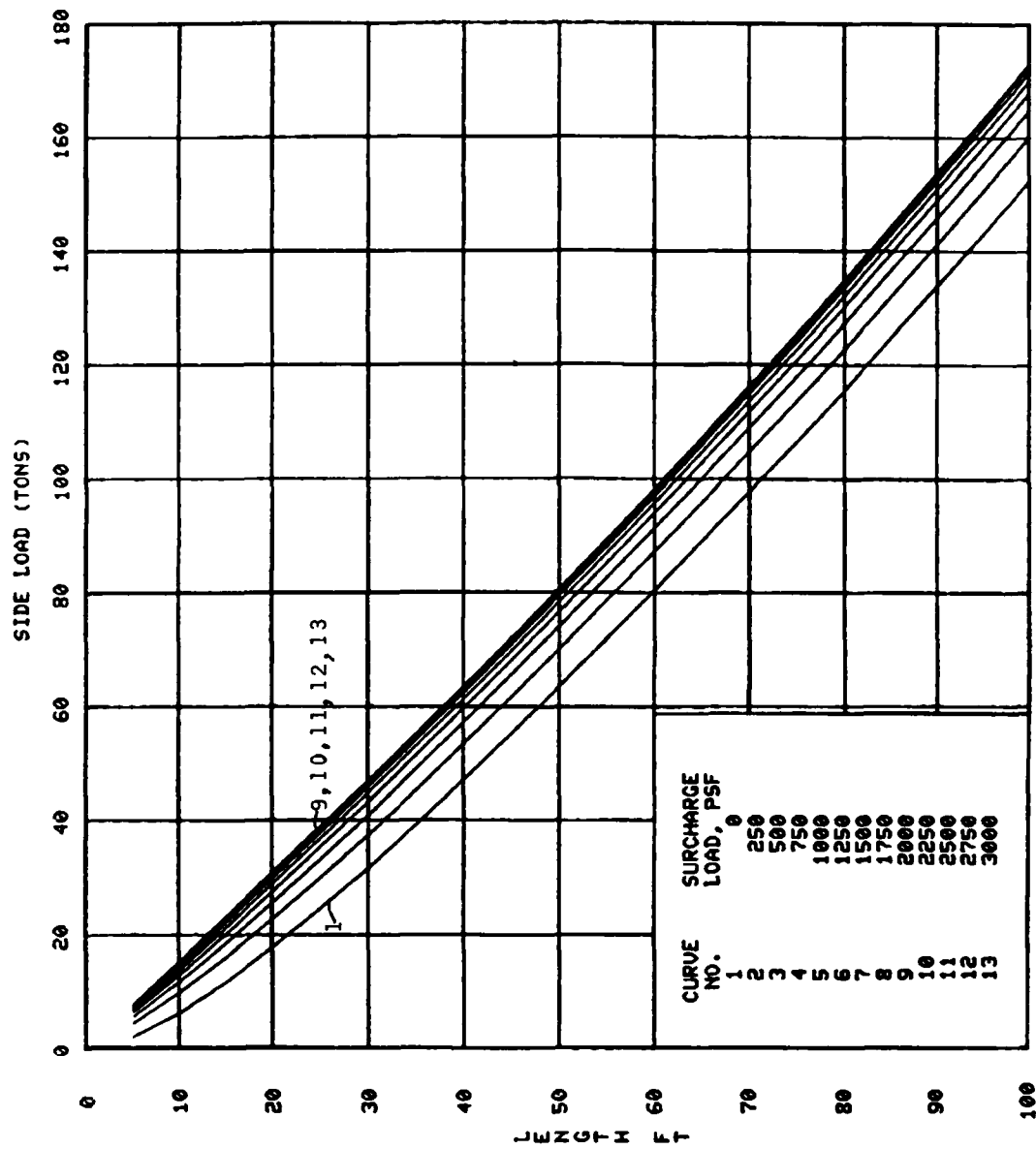


Figure 238. Side Capacity For A 10-in Concrete Filled Pipe Pile Submerged Condition, 1/4-in. Tip Movement,  $\phi=35^\circ$ ,  $C=0$ .



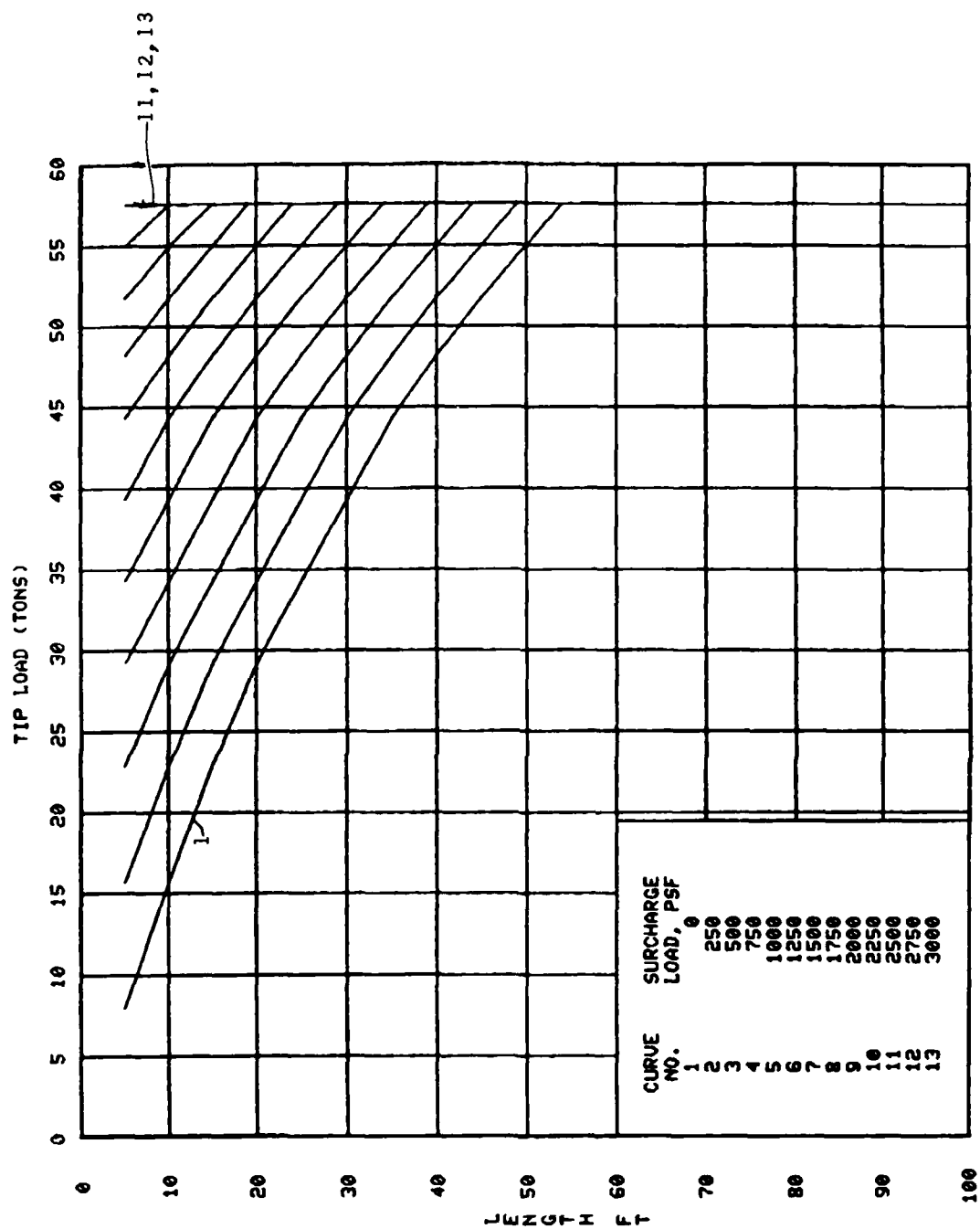


Figure 239. Tip Capacity For A 10-in Concrete Filled Pipe Pile  
Submerged Condition, 1/4-in. Tip Movement,  $\Phi=35$  Deg., C-0.



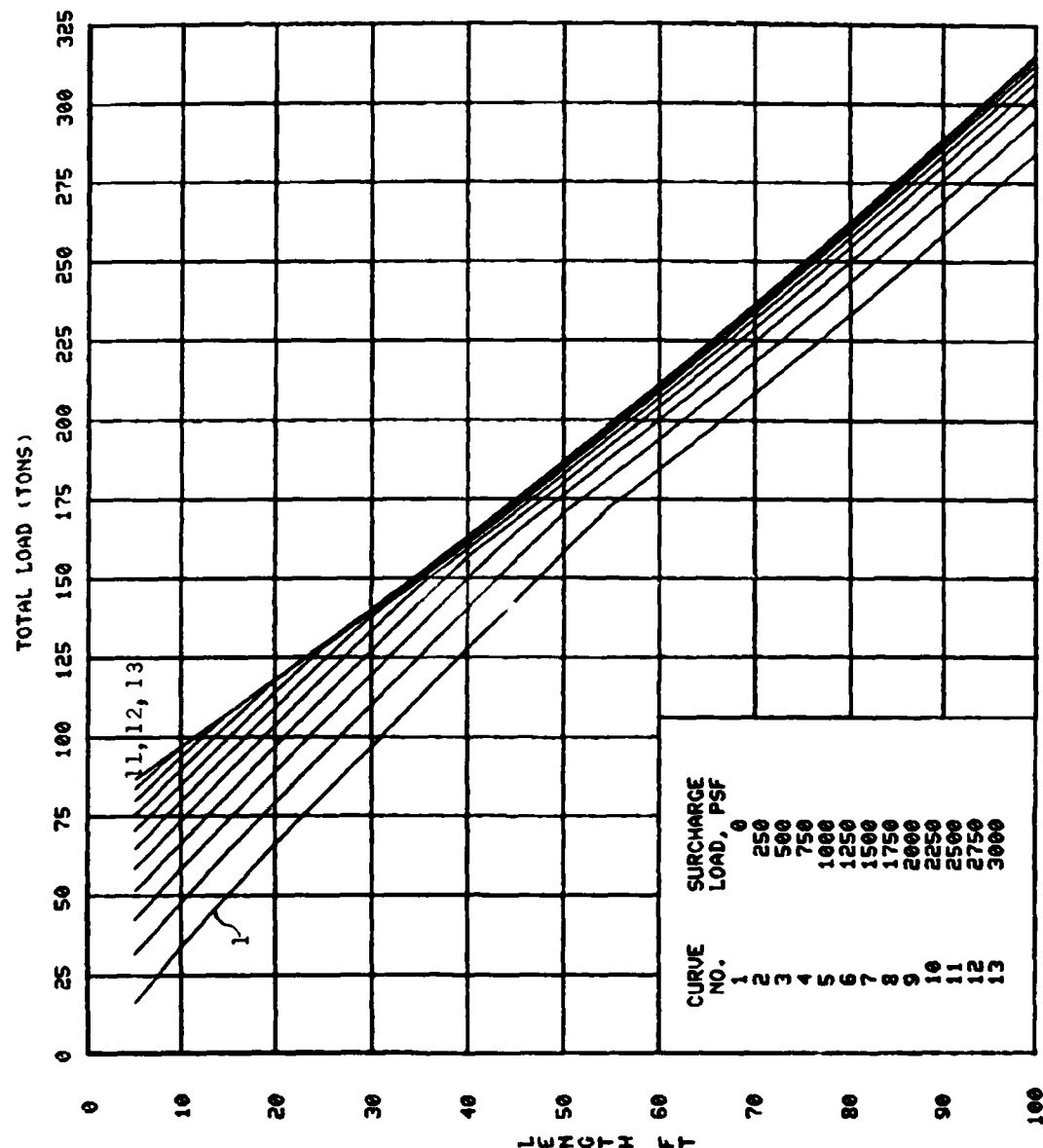


Figure 240. Total Pile Capacity For A 10-in Concrete Filled Pipe Pile Submerged Condition, 1/4-in. Tip Movement,  $\Phi=37$  Deg.,  $C=0$ .



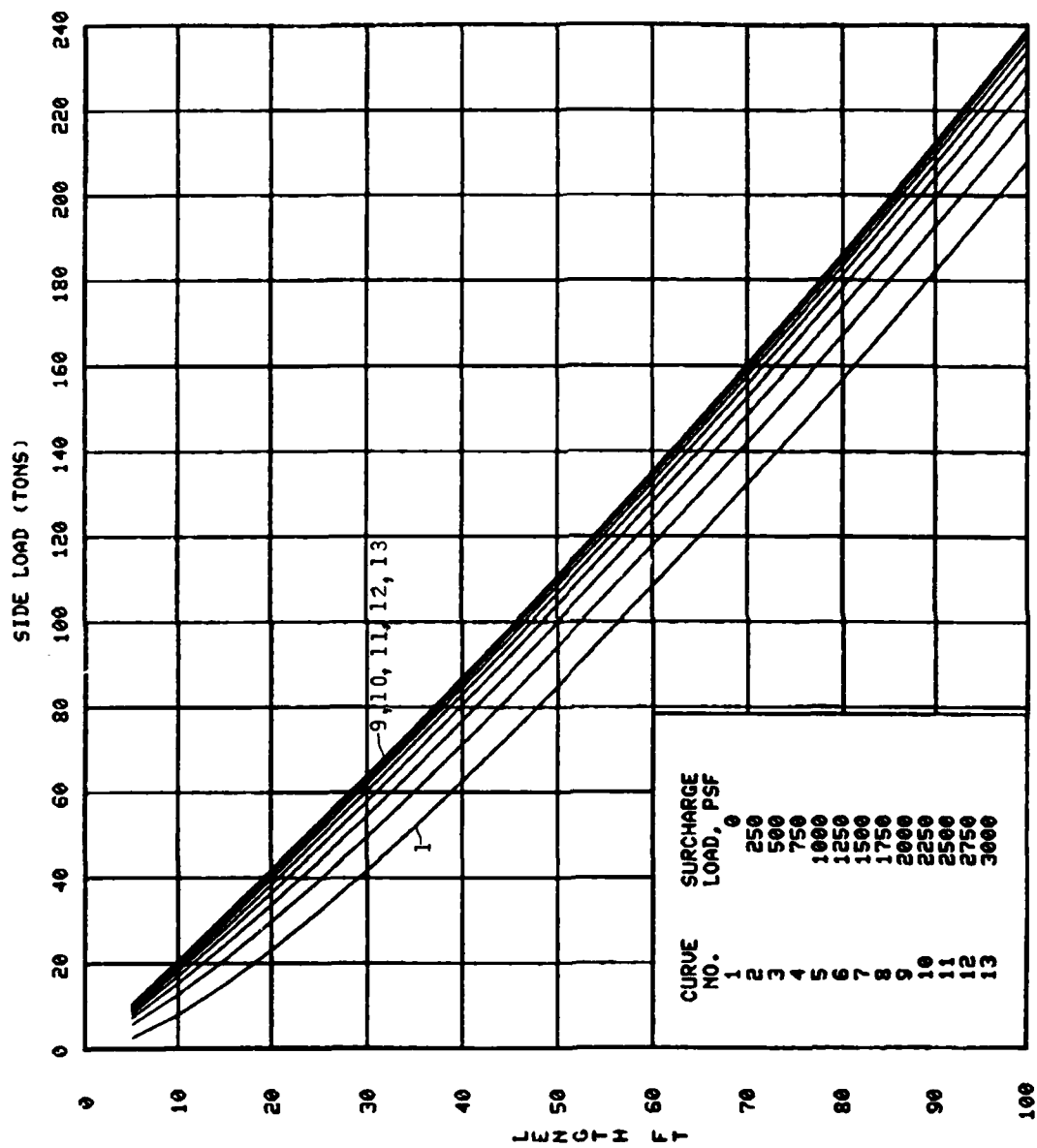


Figure 241. Side Capacity For A 10-in Concrete Filled Pipe Pile Submerged Condition, 1/4-in. Tip Movement, Phi-37 Deg., C-0.



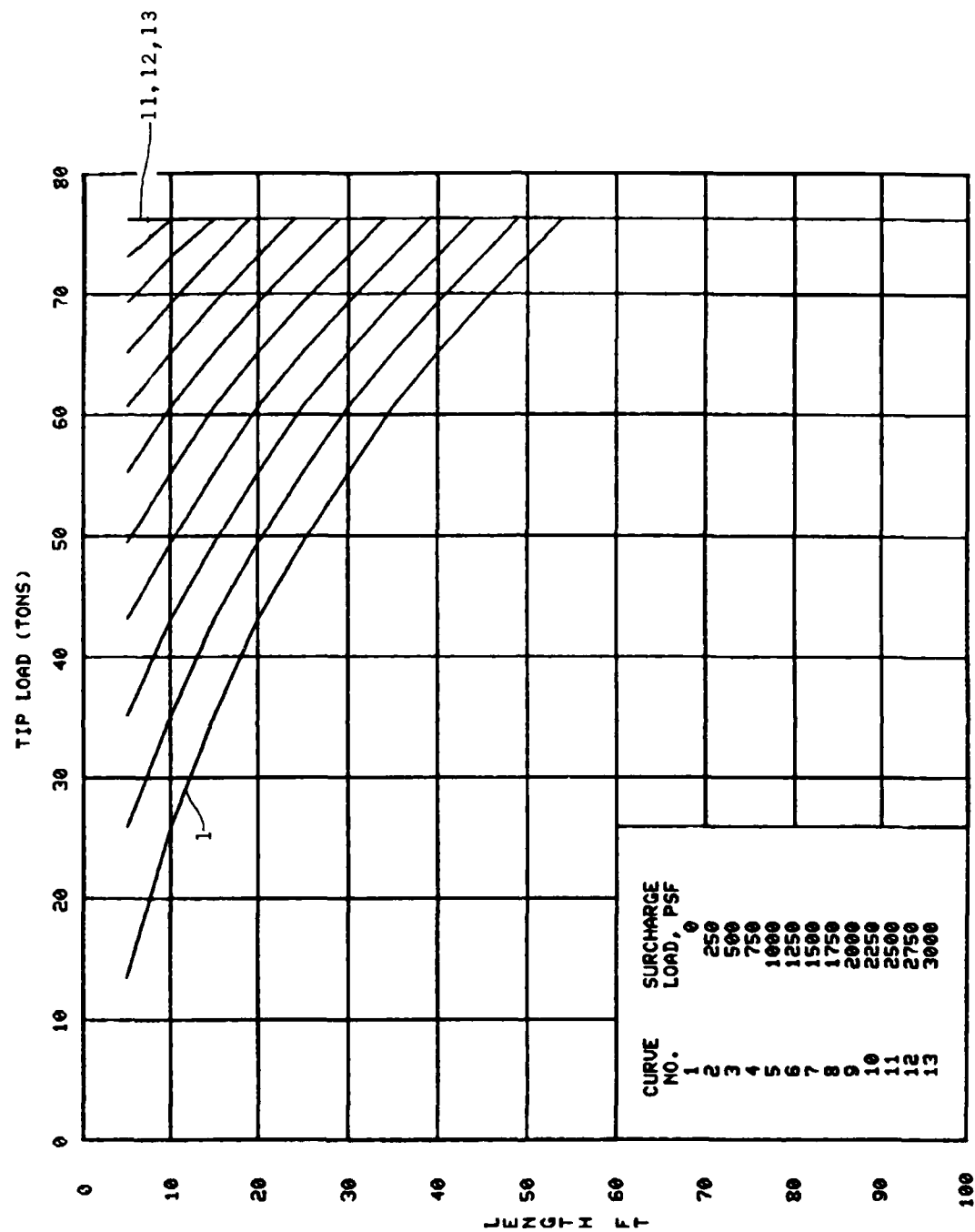


Figure 242. Tip Capacity For A 10-in Concrete Filled Pipe Pile Submerged Condition, 1/4-in. Tip Movement,  $\Phi=37$  Deg.,  $C=0$ .



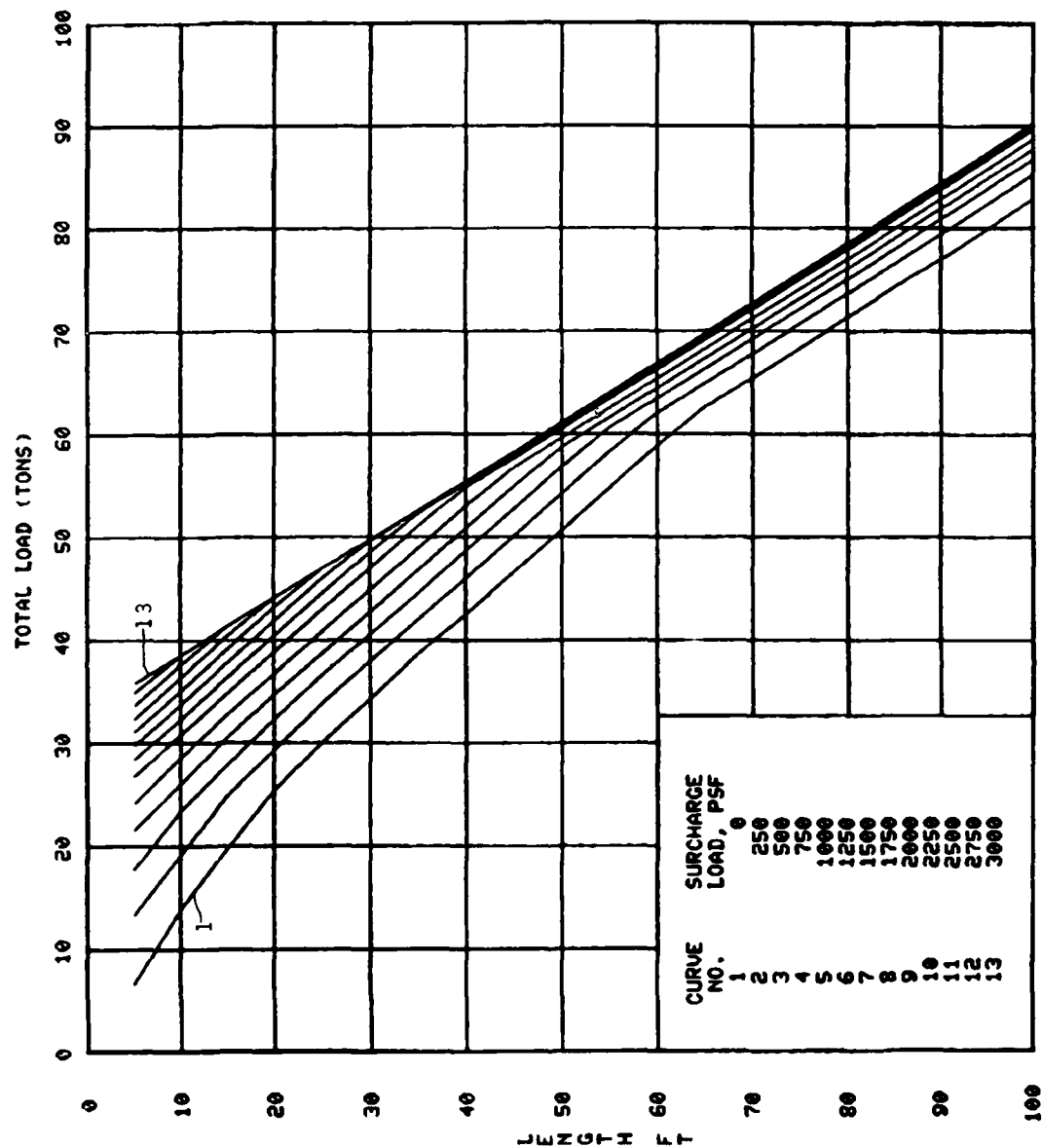


Figure 243. Total Pile Capacity For A 12-in Concrete Filled Pipe Pile Submerged Condition, 1/4-in. Tip Movement,  $\Phi=30^\circ$ ,  $C=0$ .



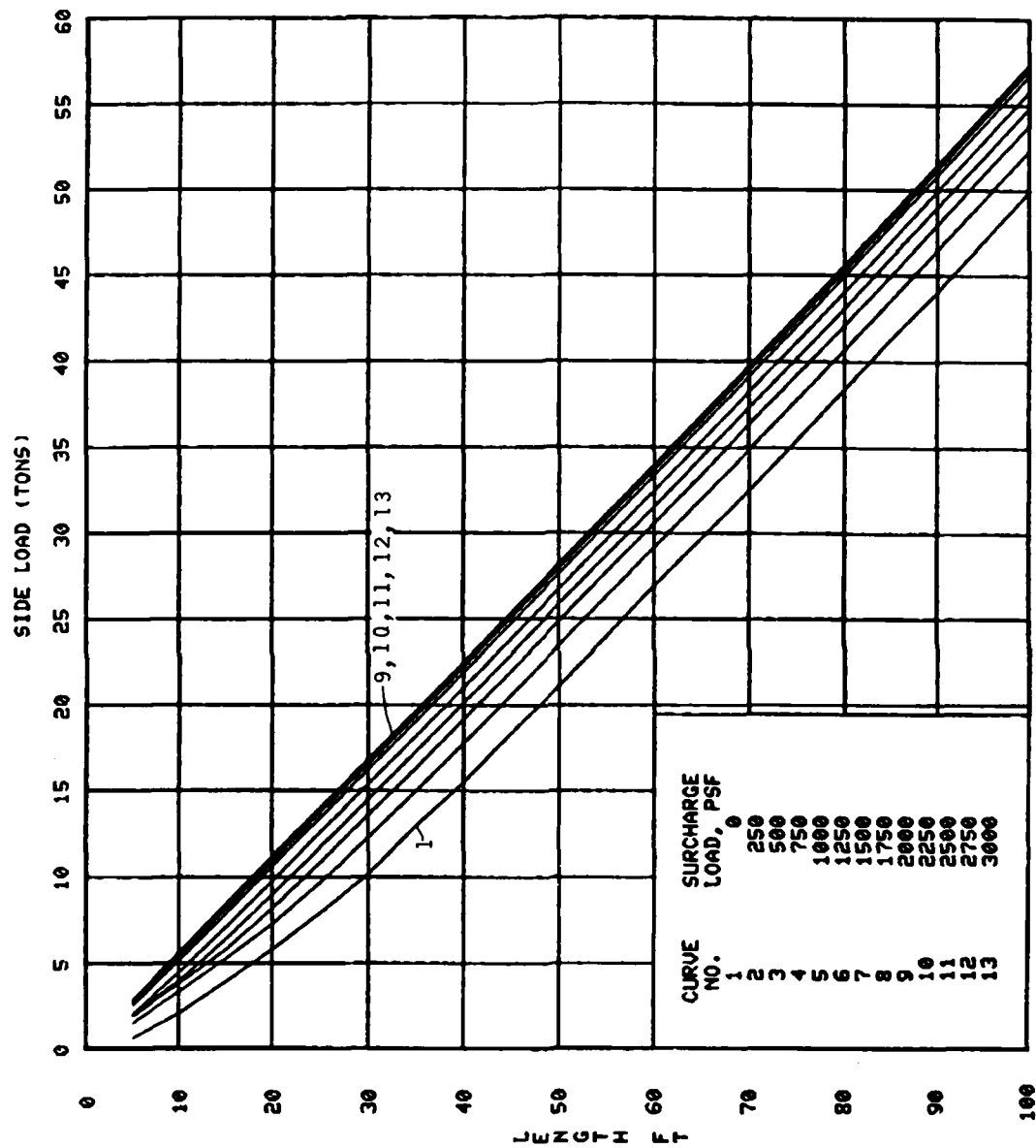


Figure 244. Side Capacity For A 12-in Concrete Filled Pipe Pile Submerged Condition, 1/4-in. Tip Movement,  $\Phi=30$  Deg.,  $C=0$ .



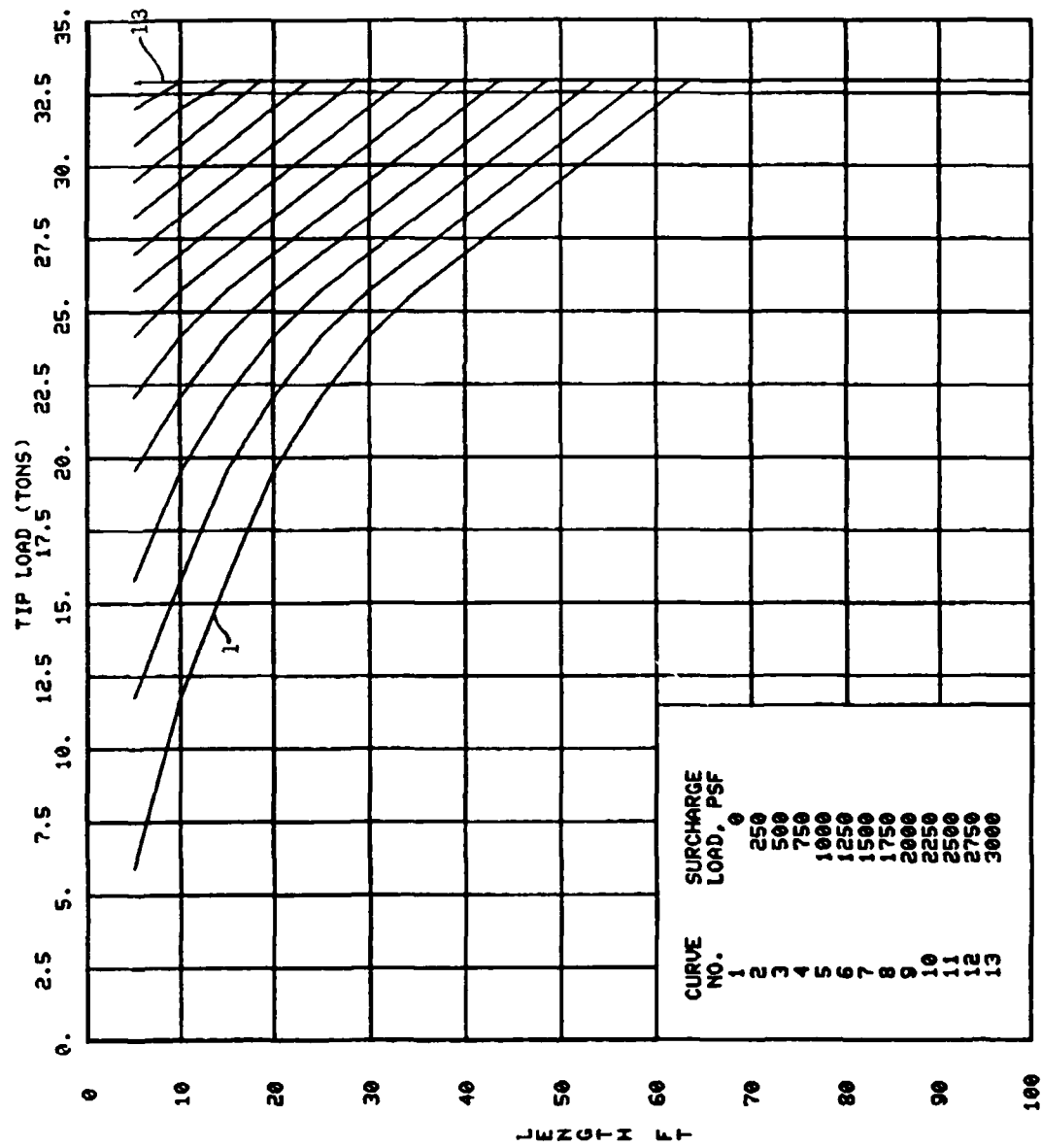


Figure 245. Tip Capacity For A 12-in Concrete Filled Pipe Pile  
Submerged Condition,  $1/4$ -in. Tip Movement,  $\Phi=30$  Deg.,  $C=0$ .



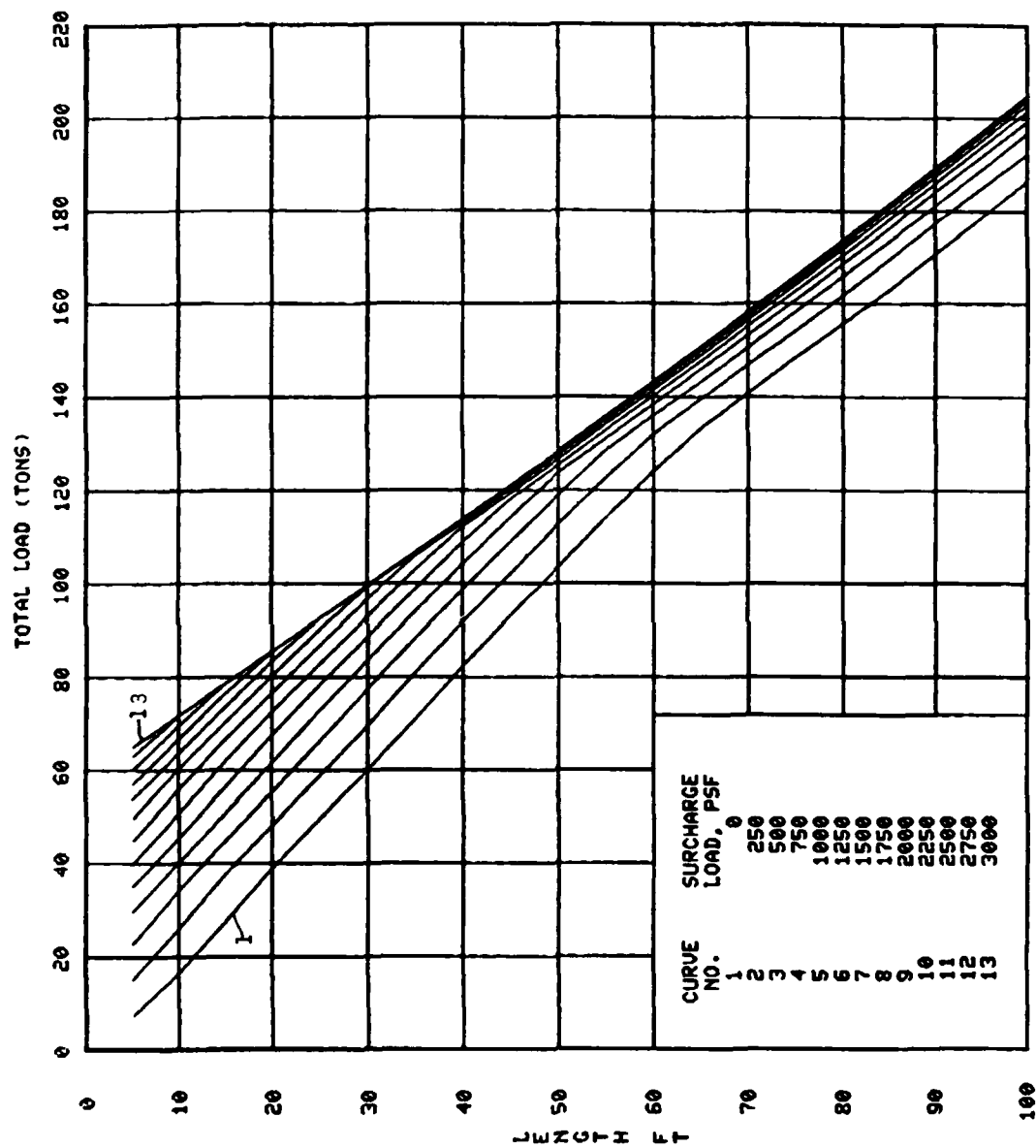


Figure 246. Total Pile Capacity For A 12-in Concrete Filled Pipe Pile Submerged Condition, 1/4-in. Tip Movement,  $\Phi=33$  Deg.,  $C=0$ .



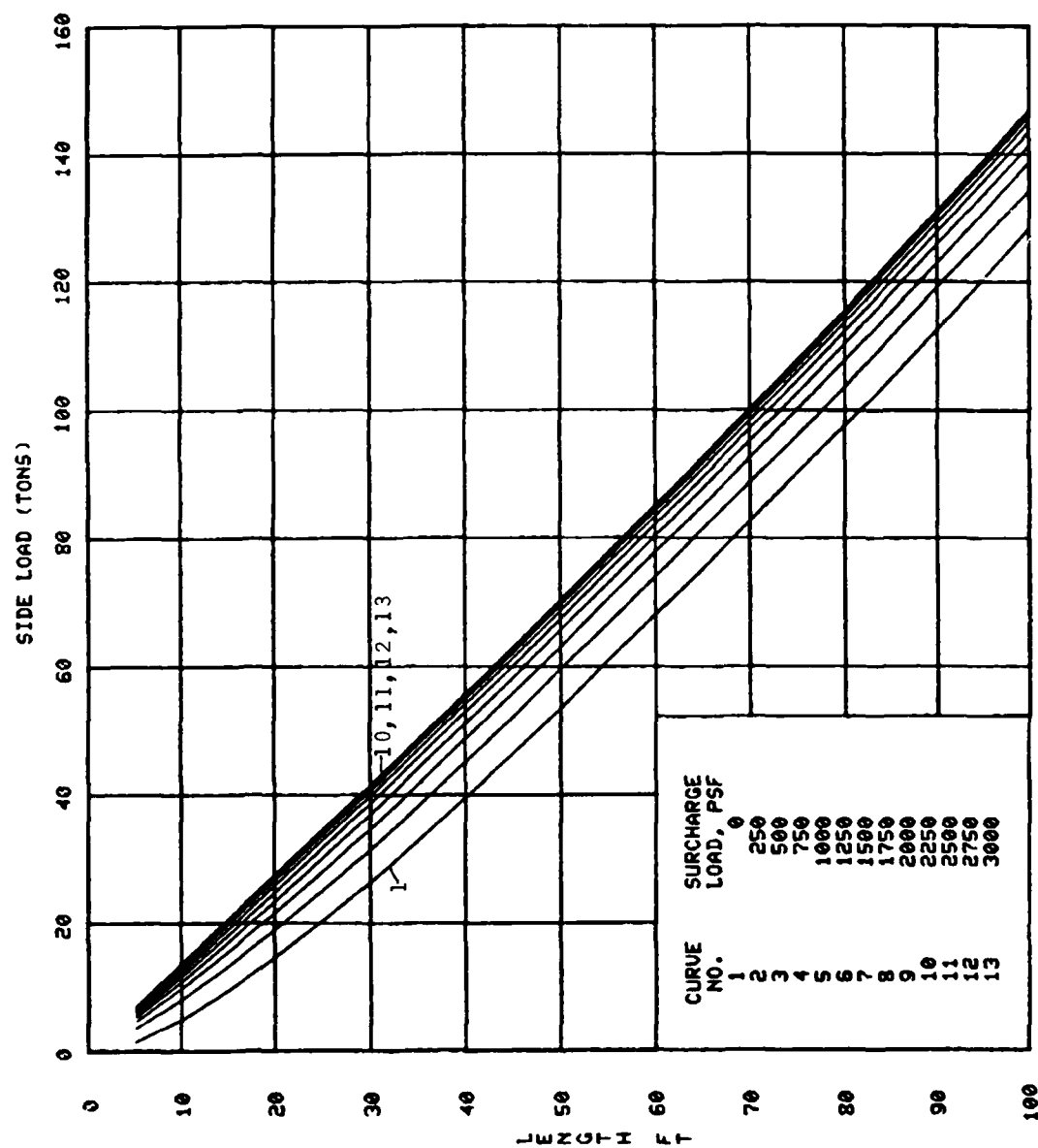


Figure 247. Side Capacity For A 12-in Concrete Filled Pipe Pile Submerged Condition, 1/4-in. Tip Movement,  $\Phi=33$  Deg.,  $C=0$ .



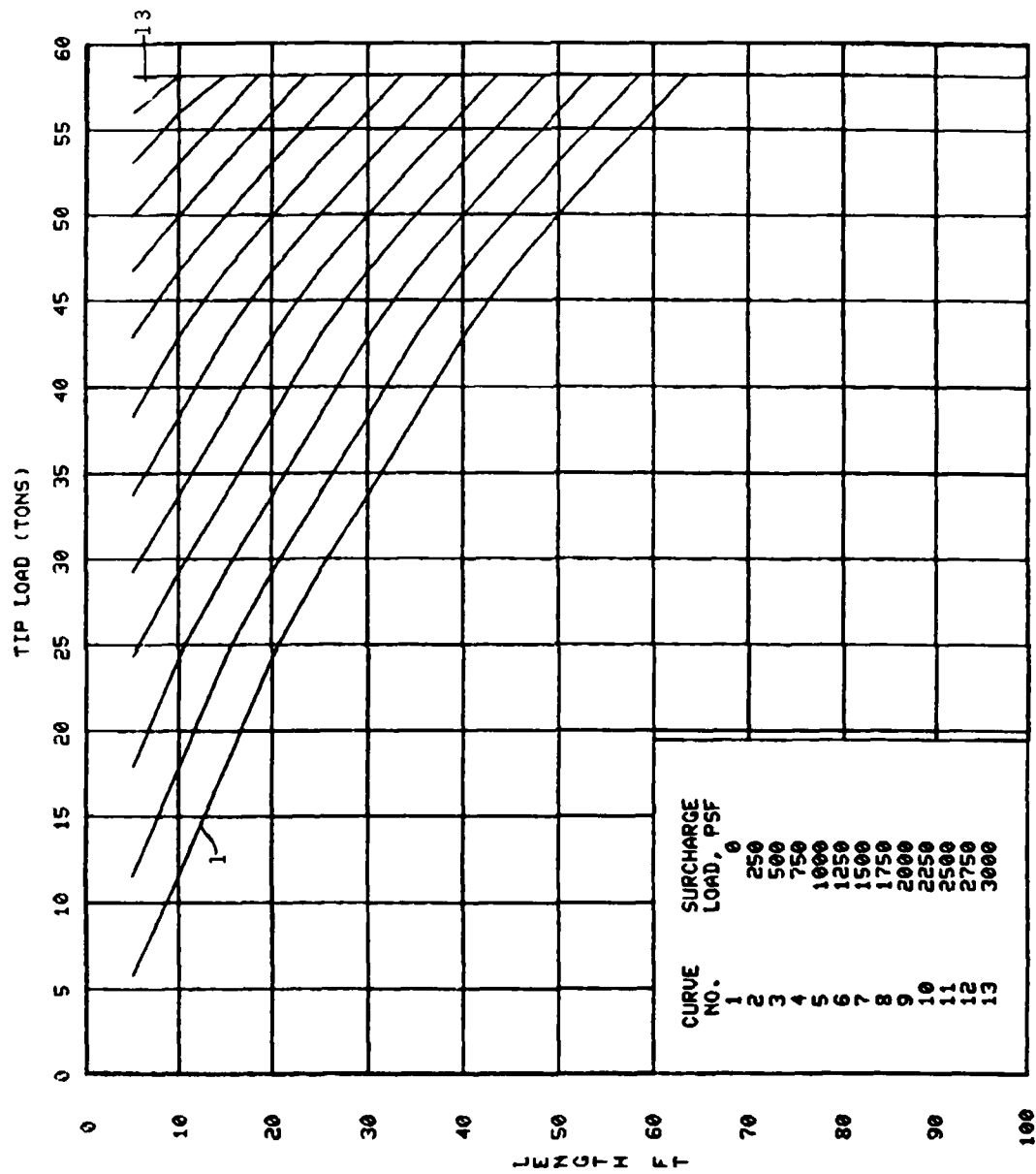


Figure 248. Tip Capacity For A 12-in Concrete Filled Pipe Pile  
Submerged Condition,  $1/4$ -in. Tip Movement,  $\Phi=33$  Deg.,  $C=0$ .



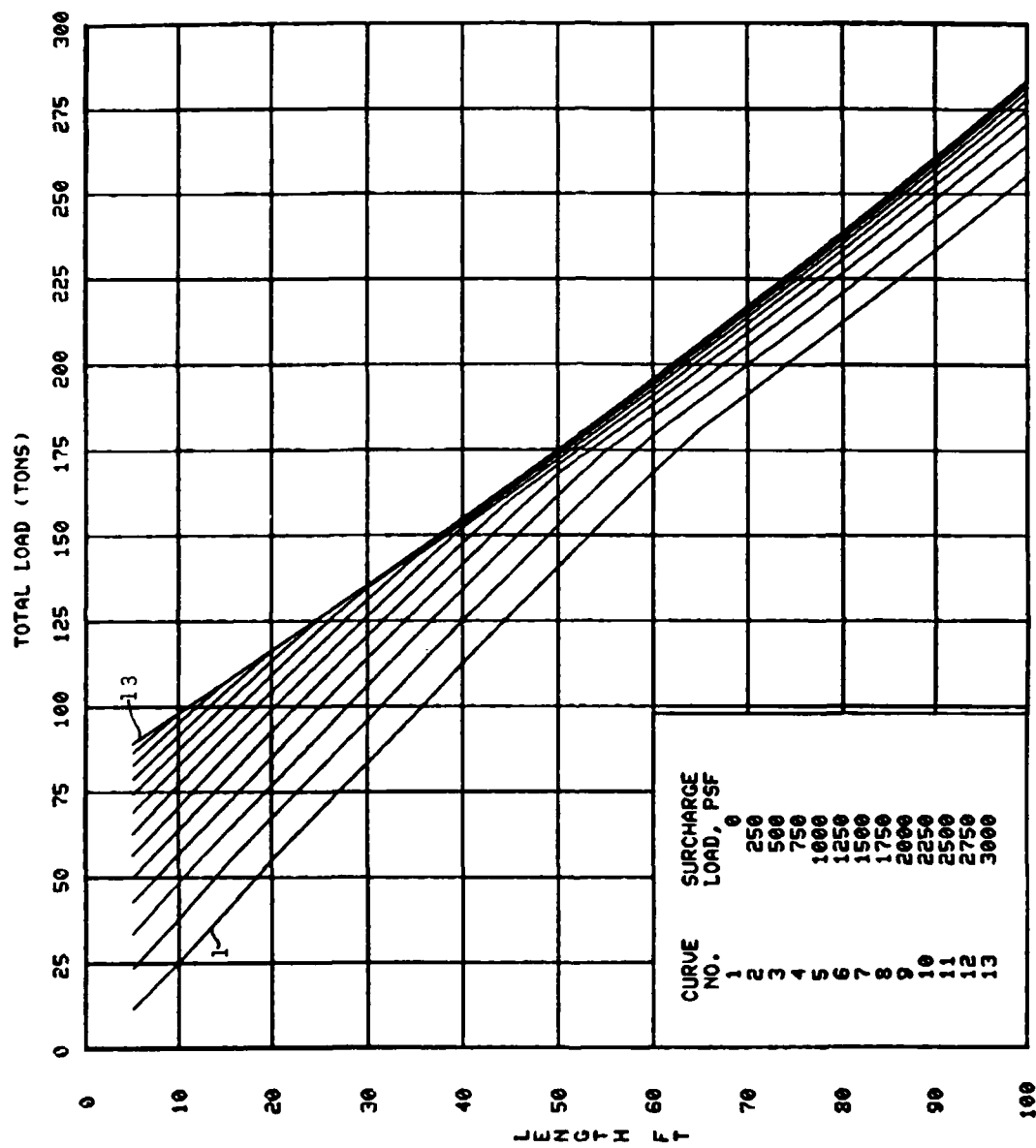


Figure 249. Total Pile Capacity For A 12-in Concrete Filled Pipe Pile Submerged Condition, 1/4-in. Tip Movement,  $\Phi_{1-35}$  Deg.,  $C=0$ .



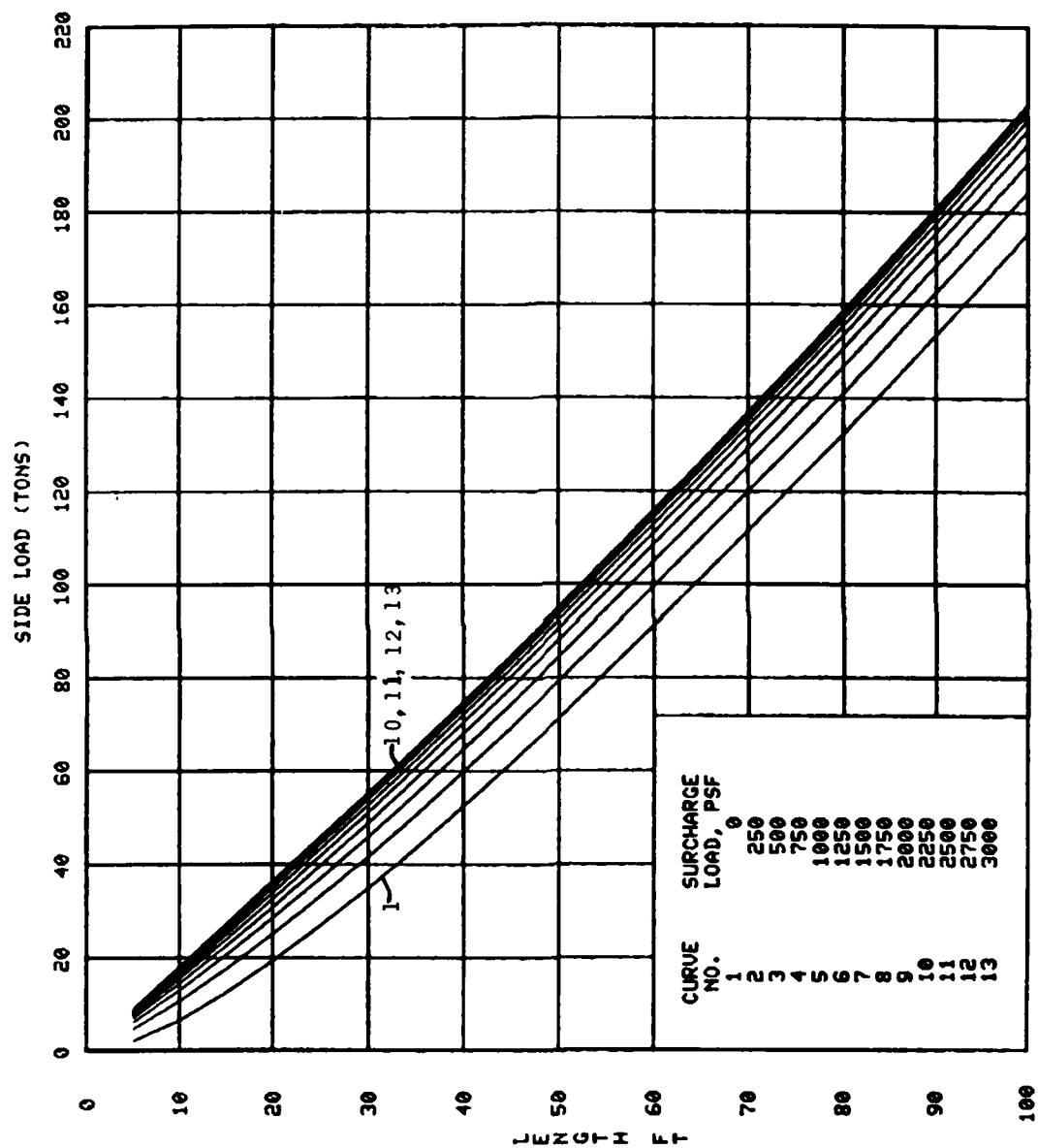


Figure 250. Side Capacity For A 12-in Concrete Filled Pipe Pile Submerged Condition, 1/4-in. Tip Movement,  $\Phi=35^\circ$ ,  $C=0$ .



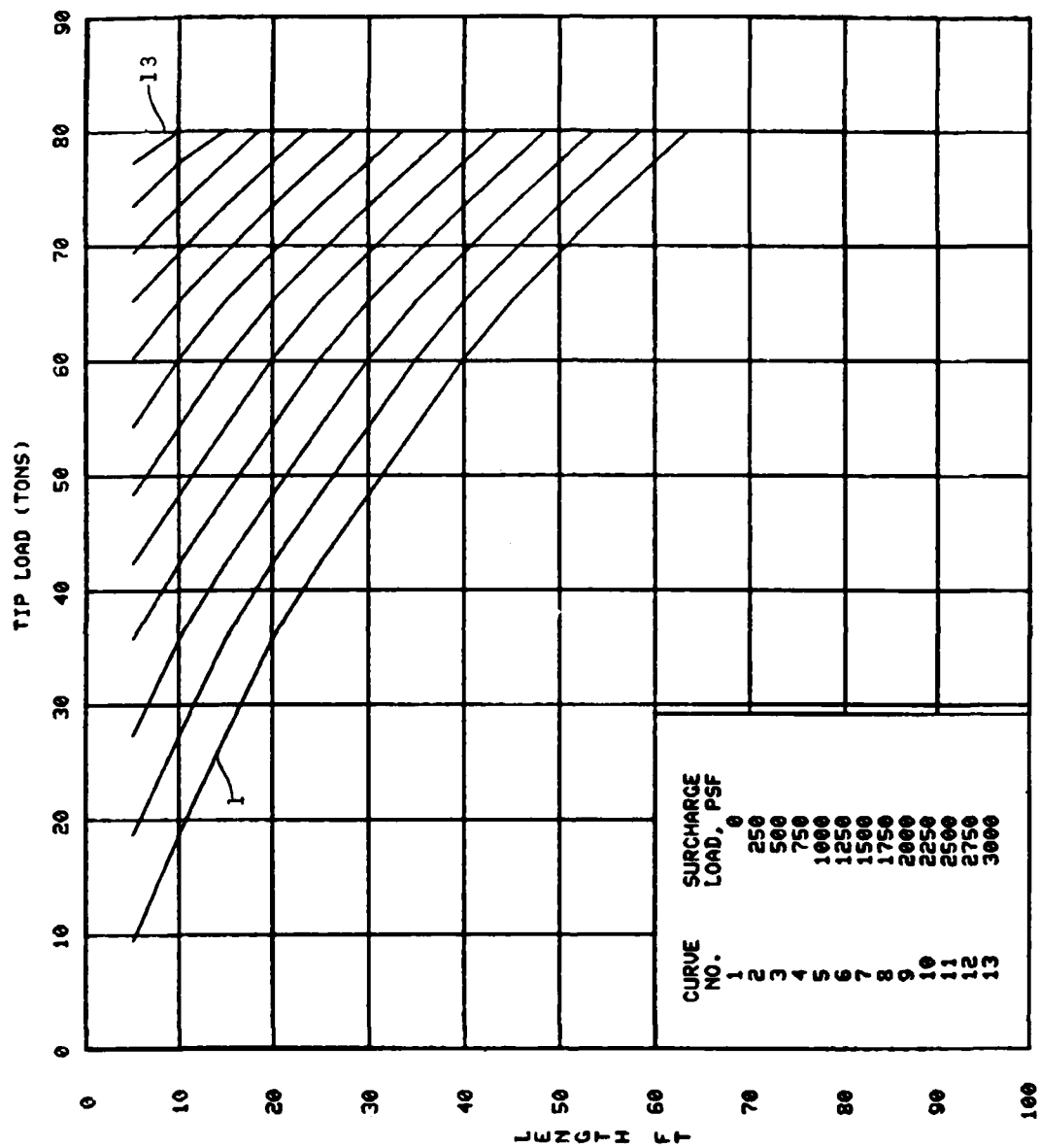


Figure 251. Tip Capacity For A 12-in Concrete Filled Pipe Pile  
Submerged Condition, 1/4-in. Tip Movement,  $\Phi=35$  Deg., C-0.



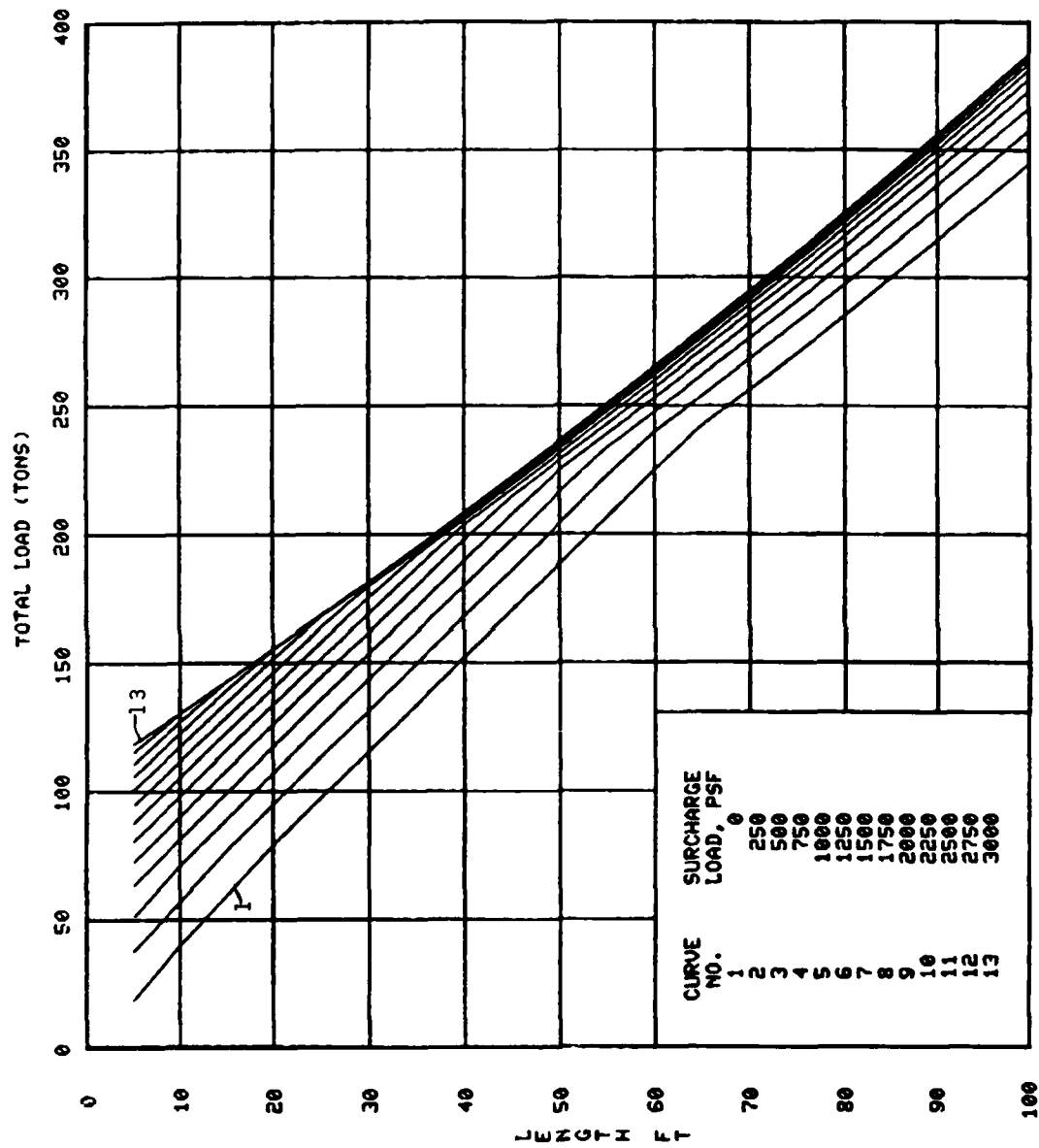


Figure 252. Total Pile Capacity For A 12-in Concrete Filled Pipe Pile Submerged Condition,  $1/4$ -in. Tip Movement,  $\Phi=37$  Deg.,  $C=0$ .



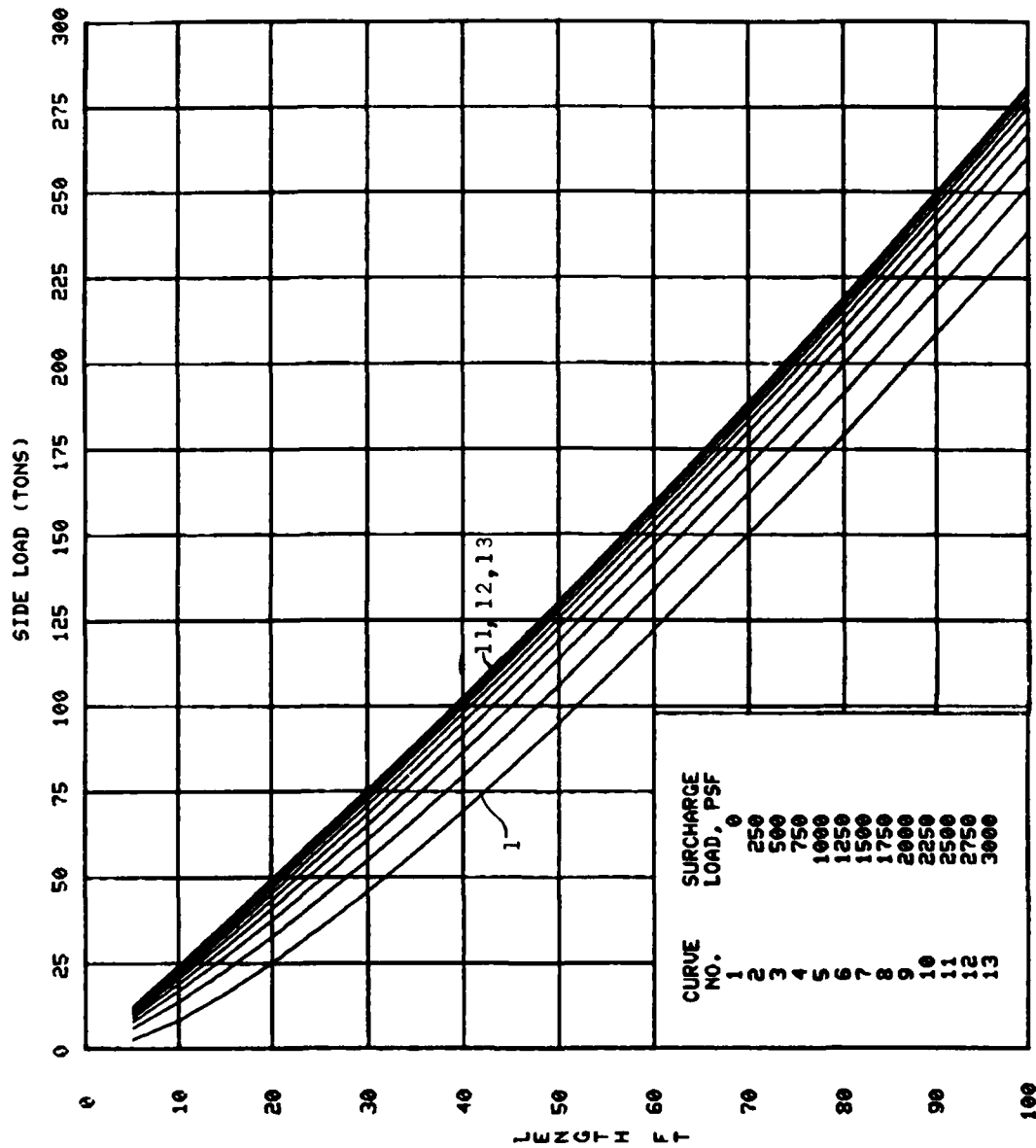


Figure 253. Side Capacity For A 12-in Concrete Filled Pipe Pile Submerged Condition, 1/4-in. Tip Movement, Phi-37 Deg., C-0.



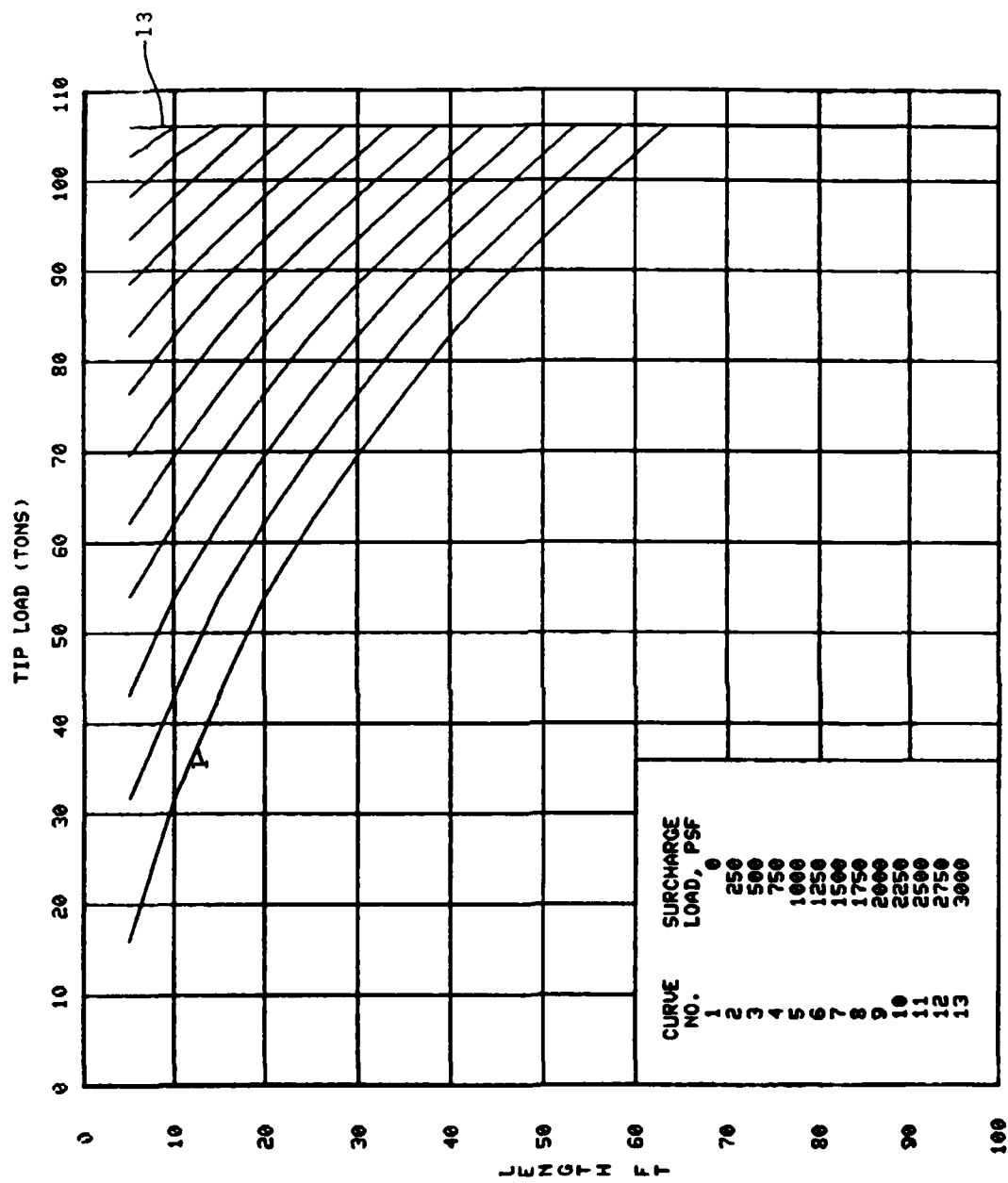


Figure 25a. Tip Capacity For A 12-in. Concrete Filled Pipe Pile Submerged Condition, 1/4-in. Tip Movement,  $\Phi=37^\circ$ ,  $C=0$ .



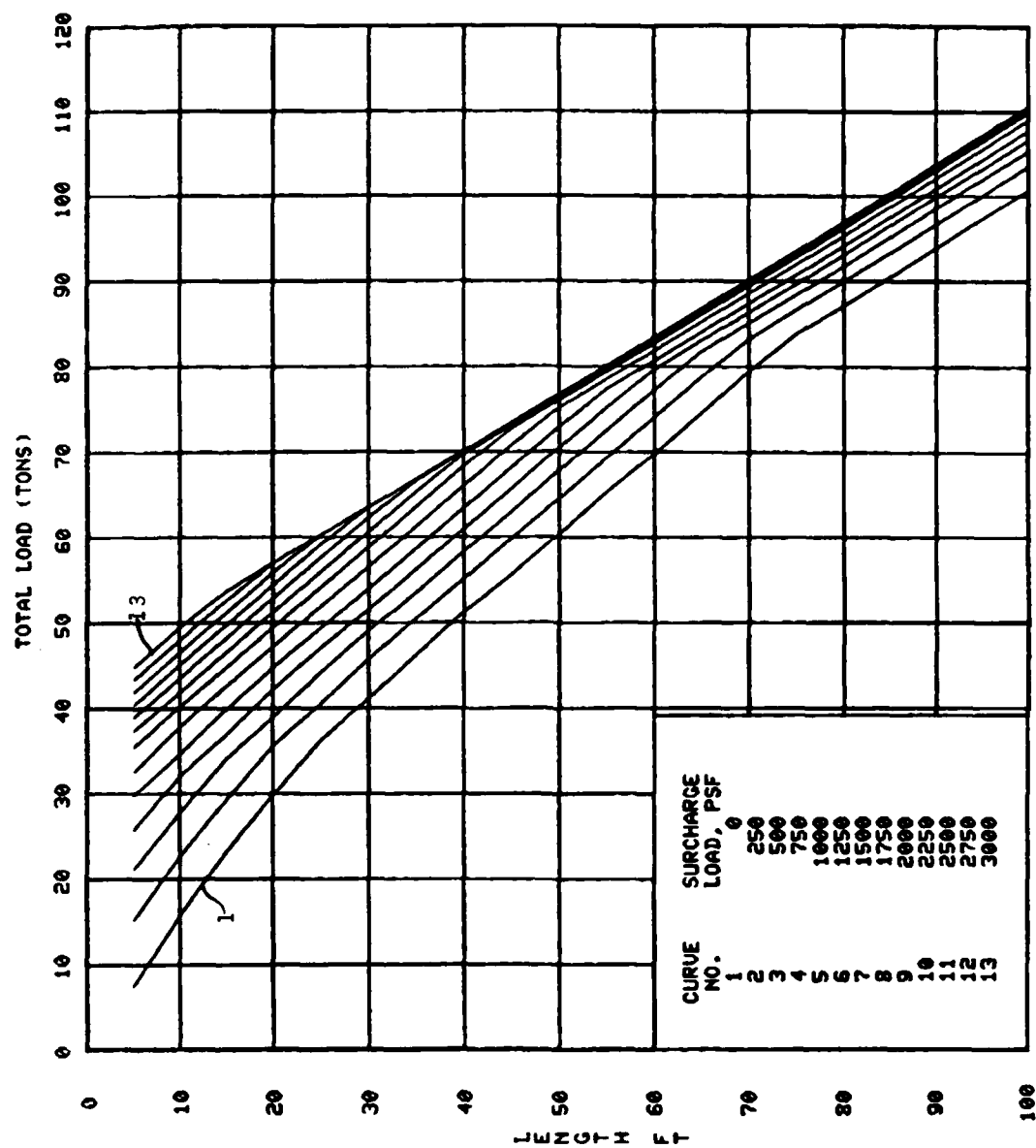


Figure 255. Total Pile Capacity For A 14-in. Concrete Filled Pipe Pile Submerged Condition, 1/4-in. Tip Movement,  $\Phi=30$  Deg.,  $C=0$ .



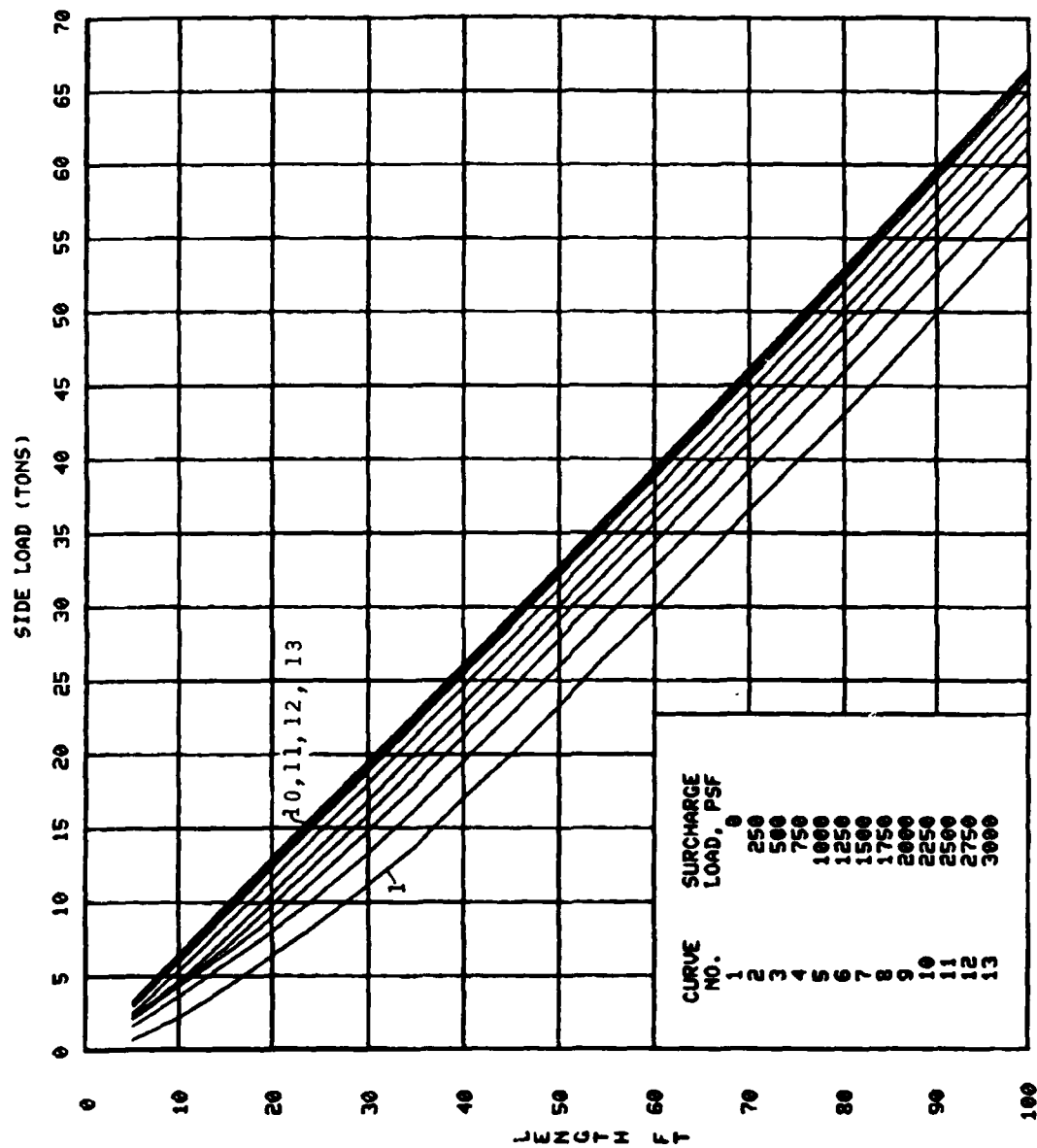


Figure 256. Side Capacity For A 14-in Concrete Filled Pipe Pile Submerged Condition, 1/4-in. Tip Movement,  $\Phi=30$  Deg.,  $C=0$ .



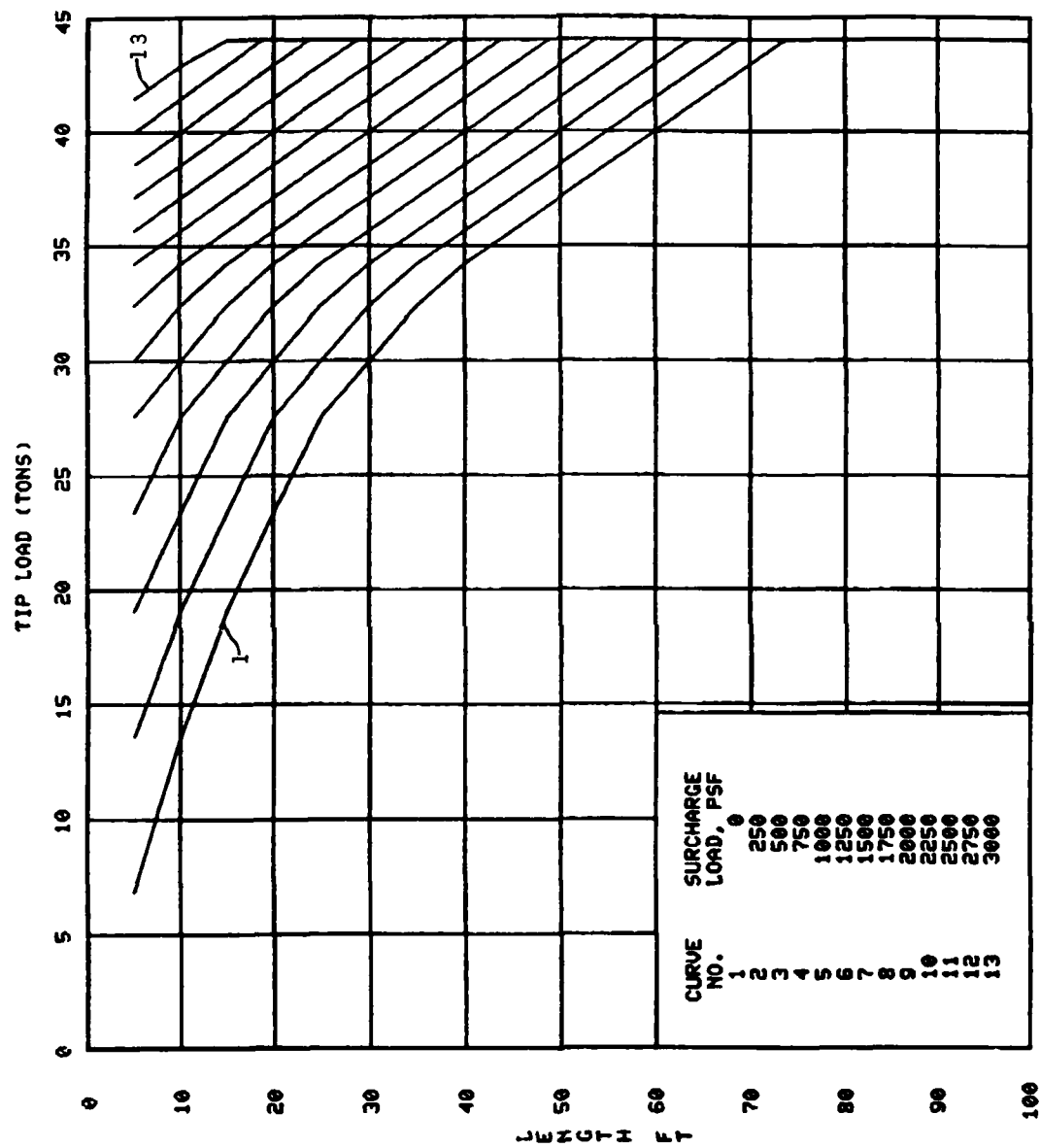


Figure 257. Tip Capacity For A 14-in. Concrete Filled Pipe Pile  
Submerged Condition, 1/4-in. Tip Movement,  $\Phi=30$  Deg., C-0.



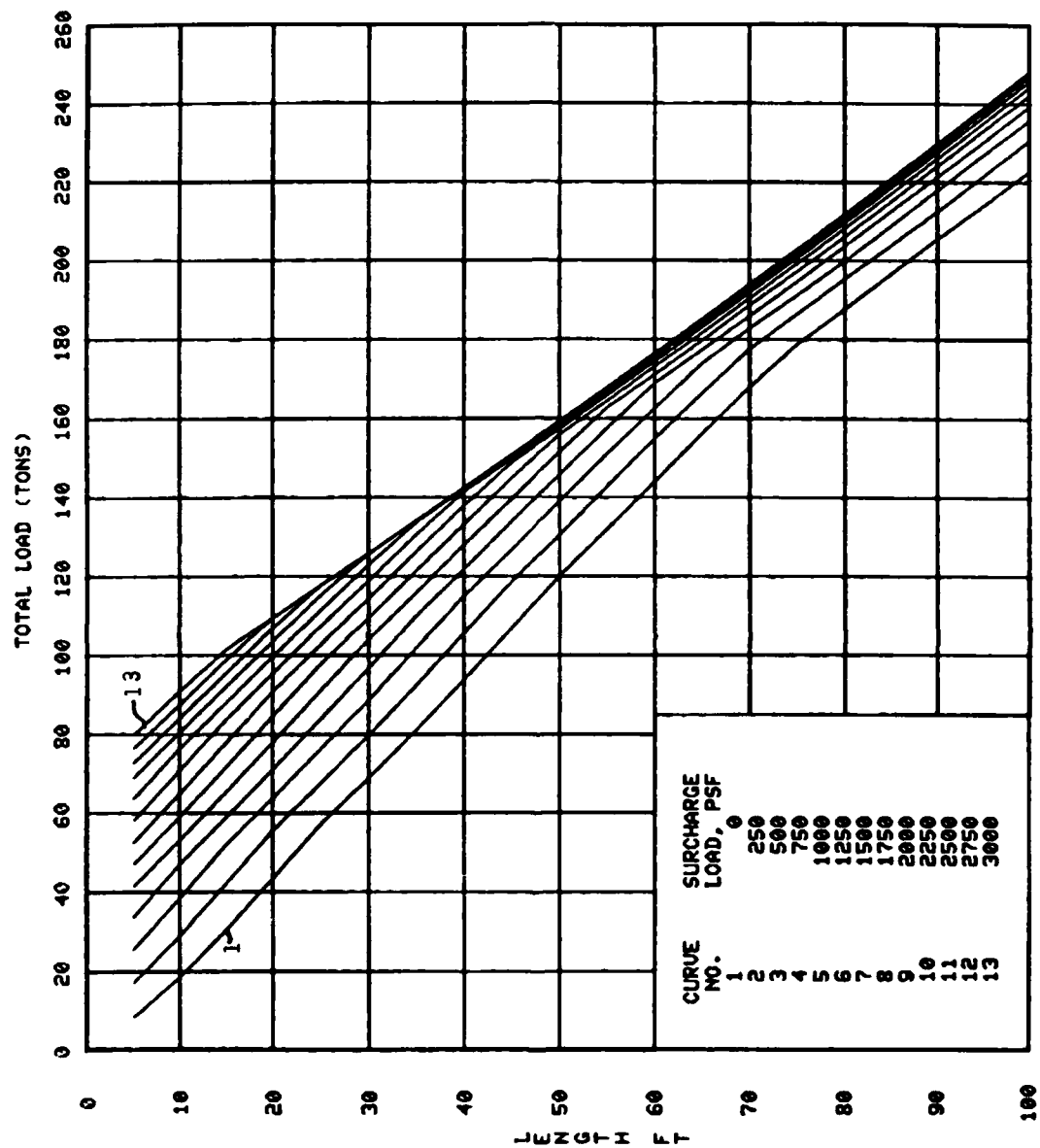


Figure 258. Total Pile Capacity For A 14-in Concrete Filled Pipe Pile Submerged Condition, 1/4-in. Tip Movement,  $\Phi=33$  Deg.,  $C=0$ .



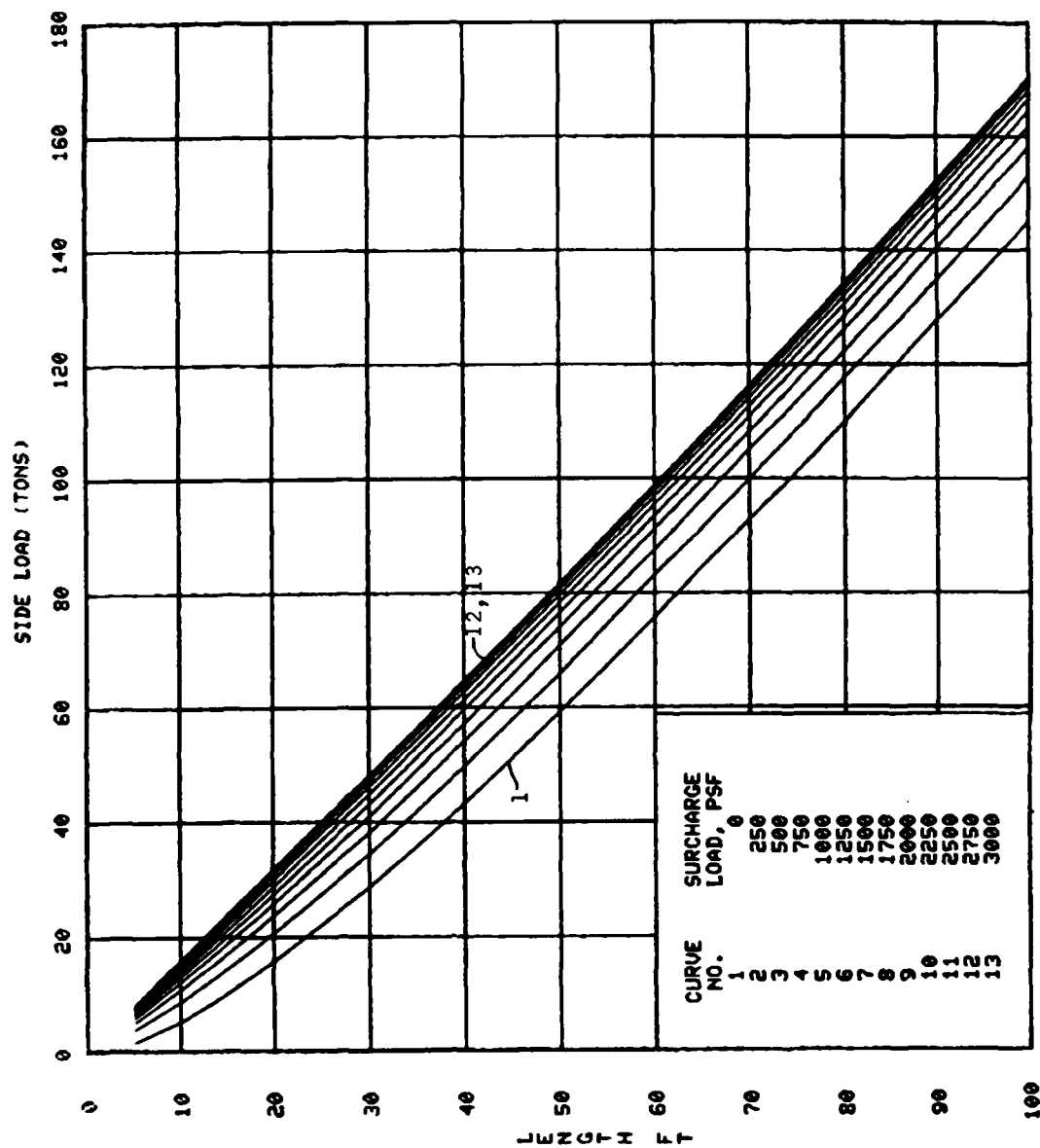


Figure 259. Side Capacity For A 14-in Concrete Filled Pipe Pile Submerged Condition, 1/4-in. Tip Movement,  $\Phi=33$  Deg.,  $C=0$ .



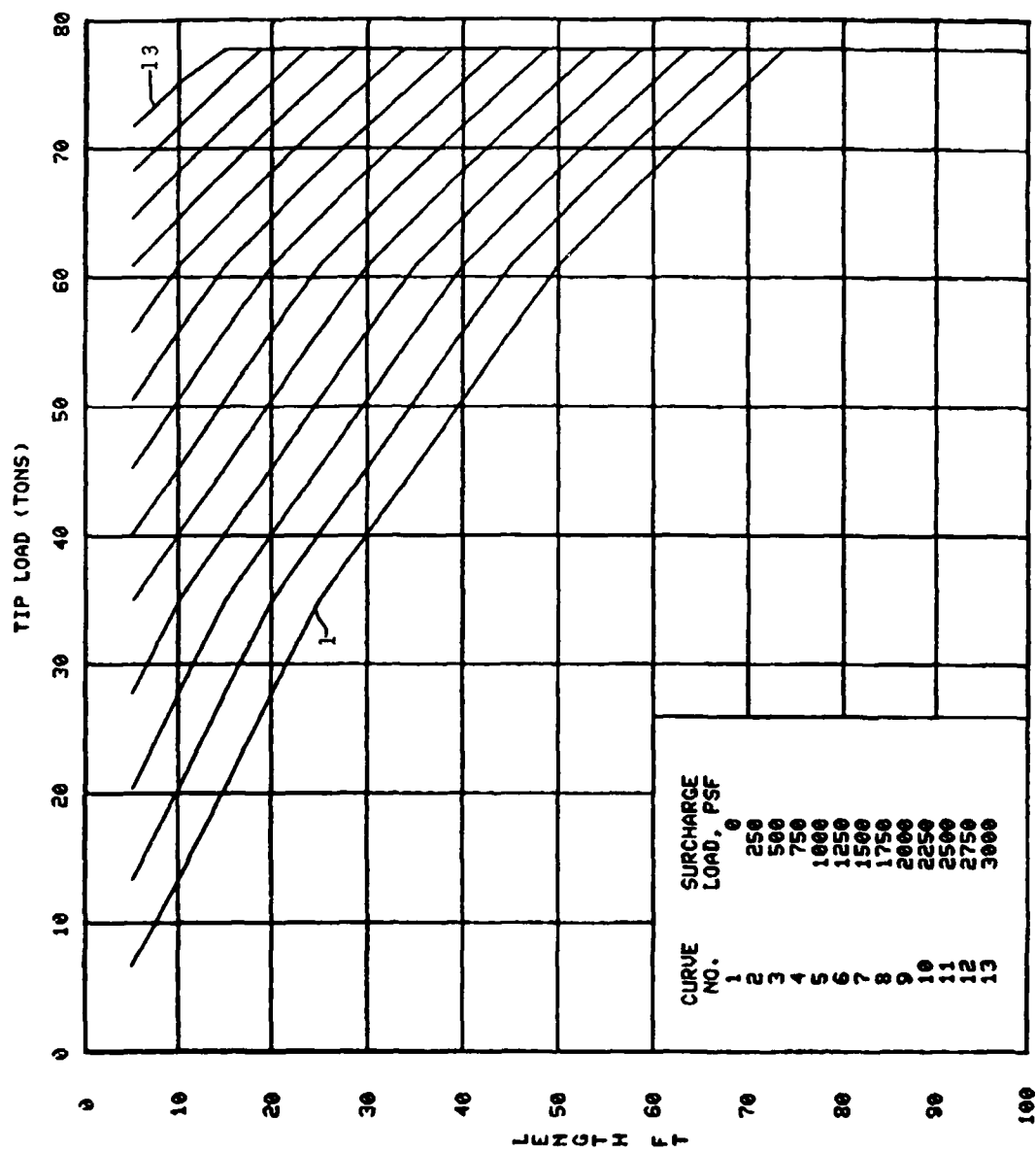


Figure 260. Tip Capacity For A 14-in Concrete Filled Pipe Pile Submerged Condition, 1/4-in. Tip Movement,  $\Phi=33$  Deg.,  $C=0$ .



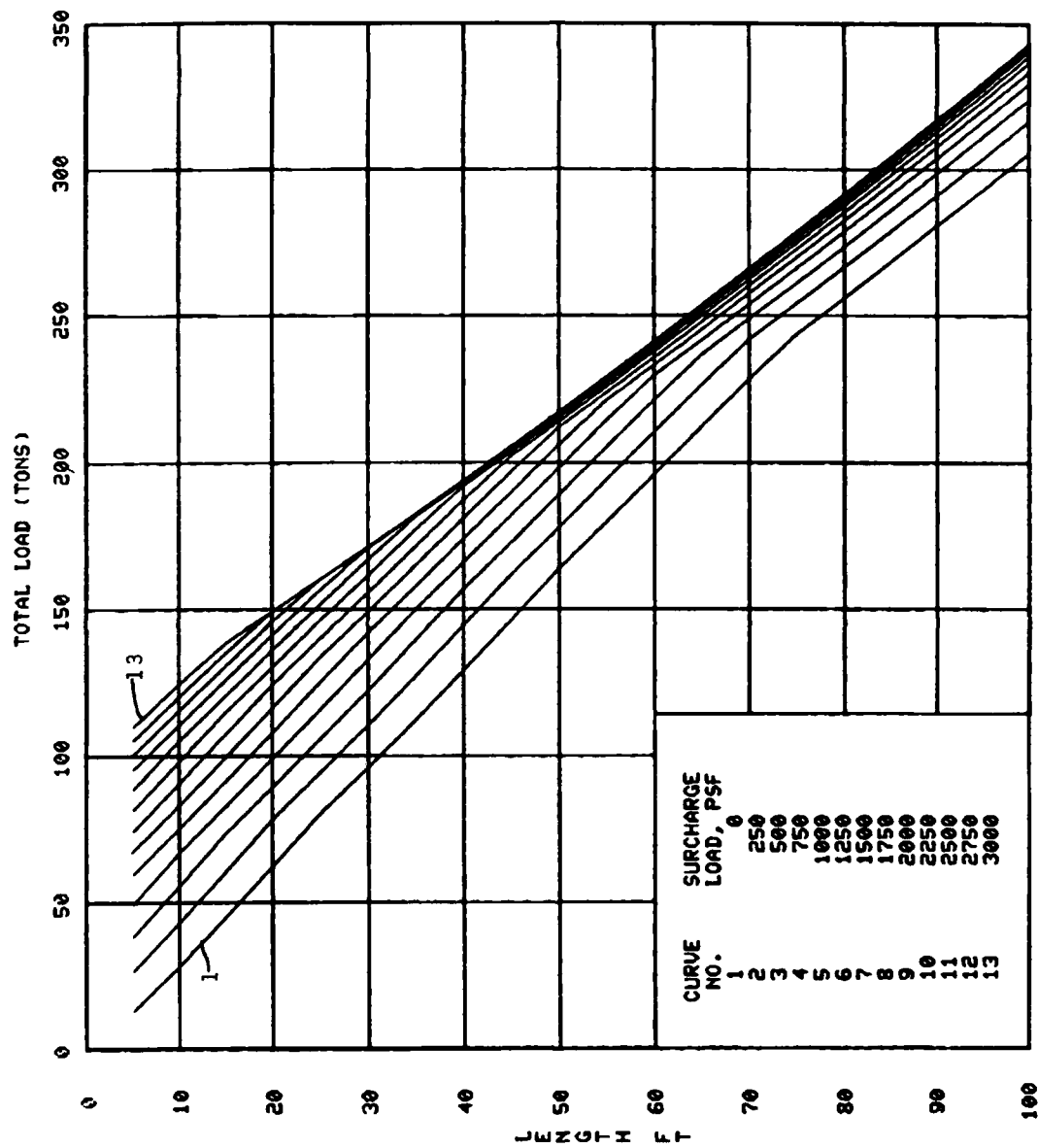


Figure 26i. Total Pile Capacity For A 14-in Concrete Filled Pipe Pile Submerged Condition, 1/4-in. Tip Movement,  $\Phi=35$  Deg.,  $C=0$ .



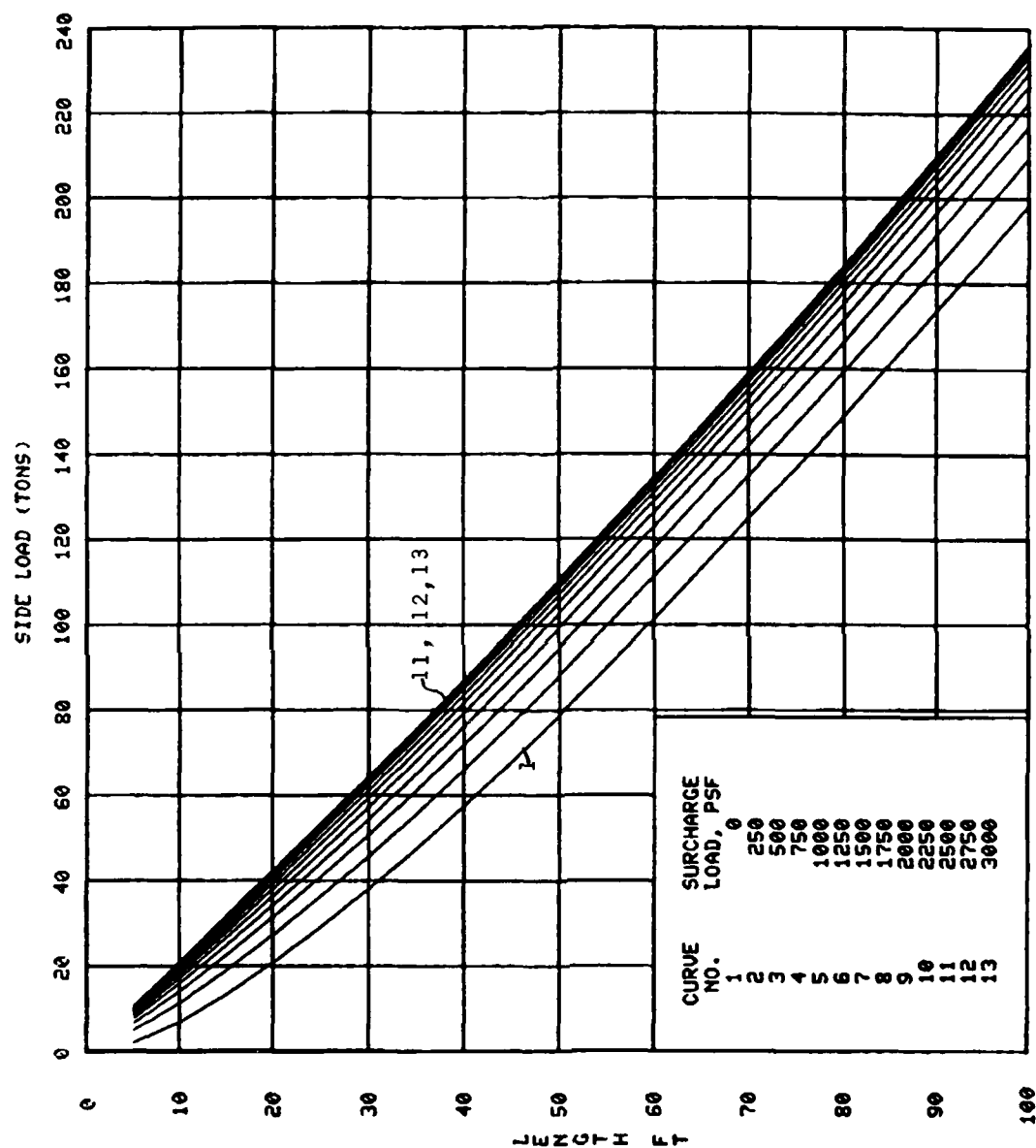


Figure 262. Side Capacity For A 14-in Concrete Filled Pipe Pile Submerged Condition, 1/4-in. Tip Movement,  $\Phi=35$  Deg.,  $C=0$ .



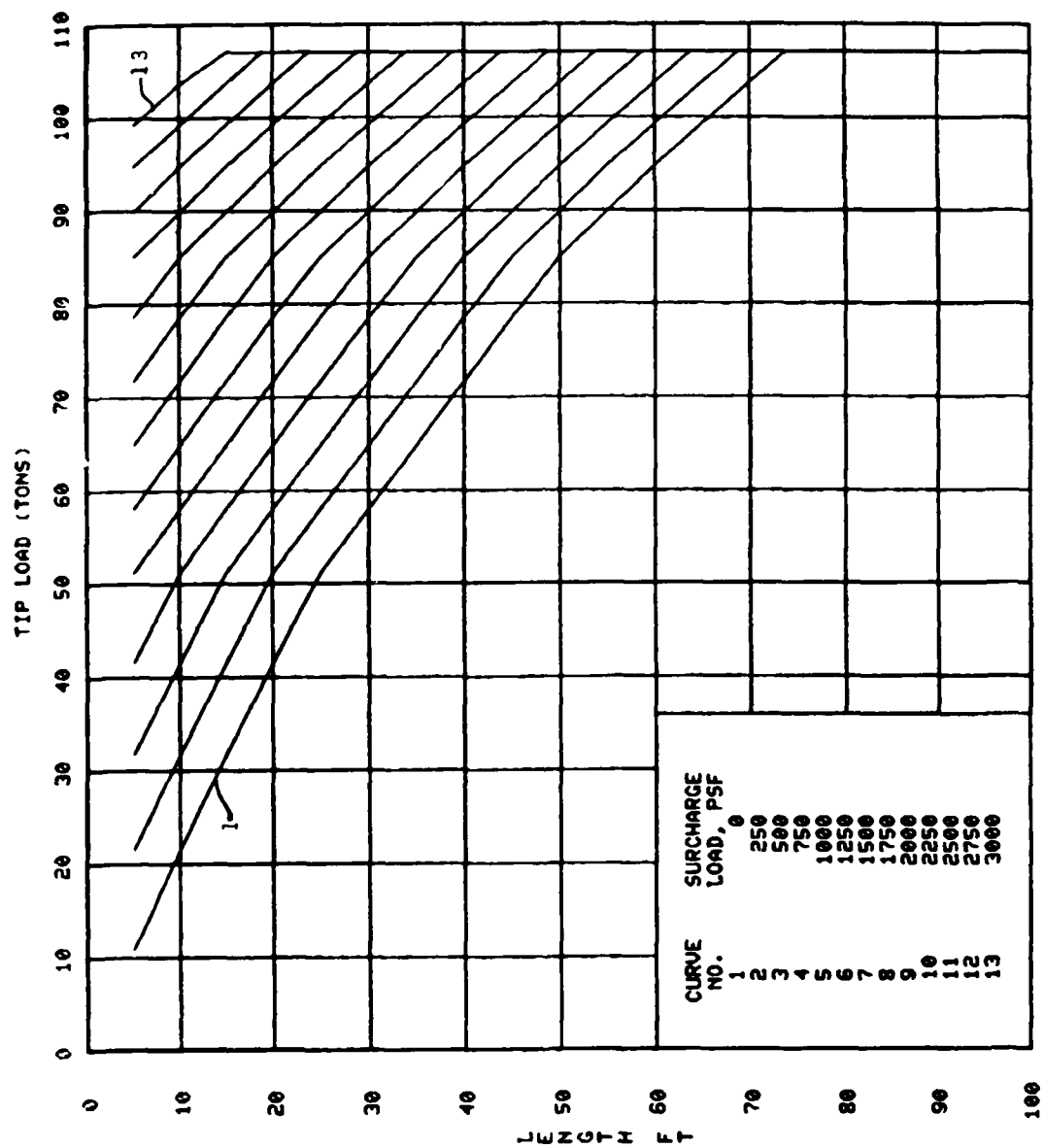


Figure 263. Tip Capacity For A 14-in Concrete Filled Pipe Pile Submerged Condition,  $1/4$ -in. Tip Movement,  $\Phi=35$  Deg.,  $C=0$ .



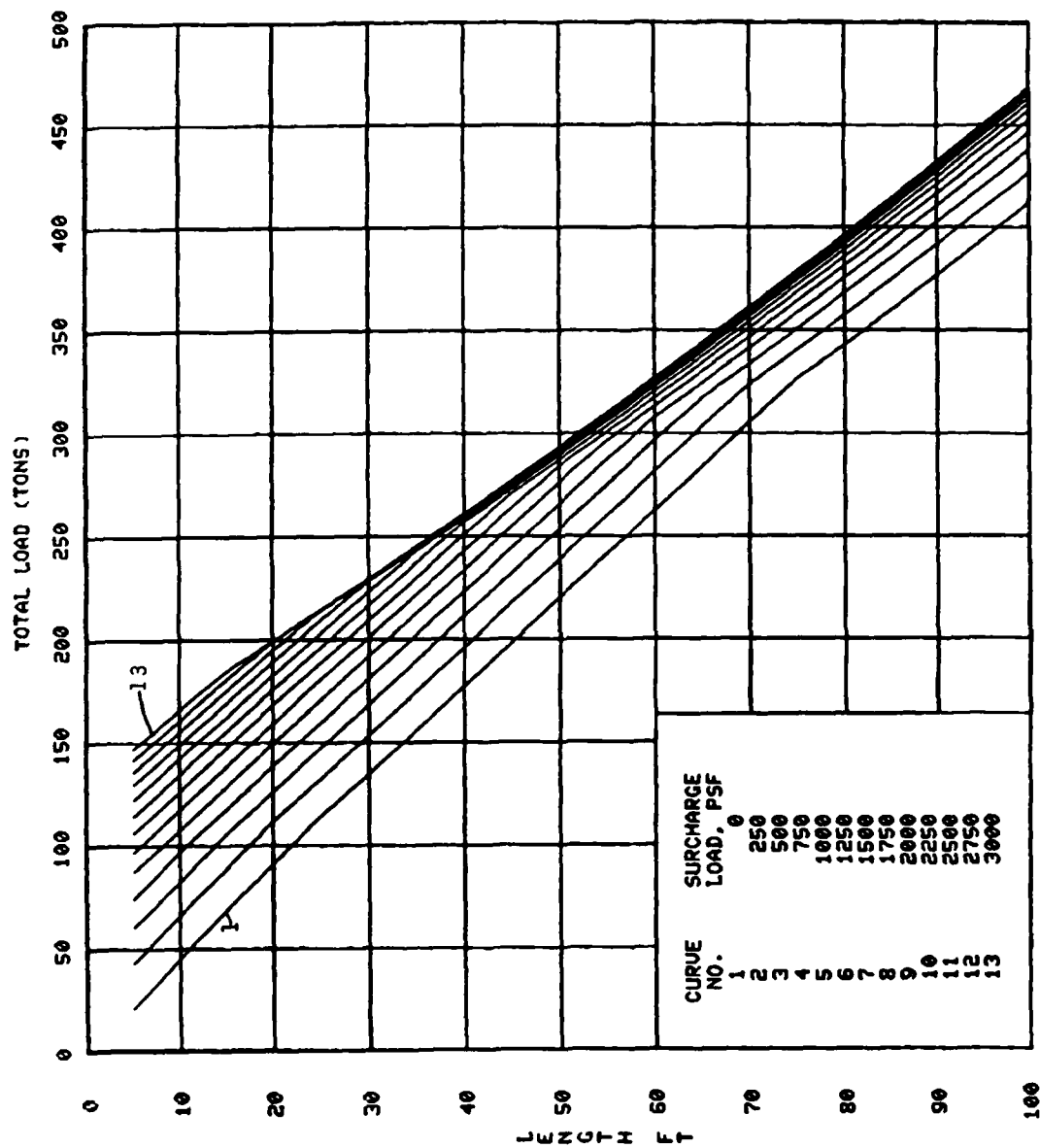


Figure 264. Total Pile Capacity For A 14-in Concrete Filled Pipe Pile Submerged Condition, 1/4-in. Tip Movement,  $\Phi=37$  Deg.,  $C=0$ .



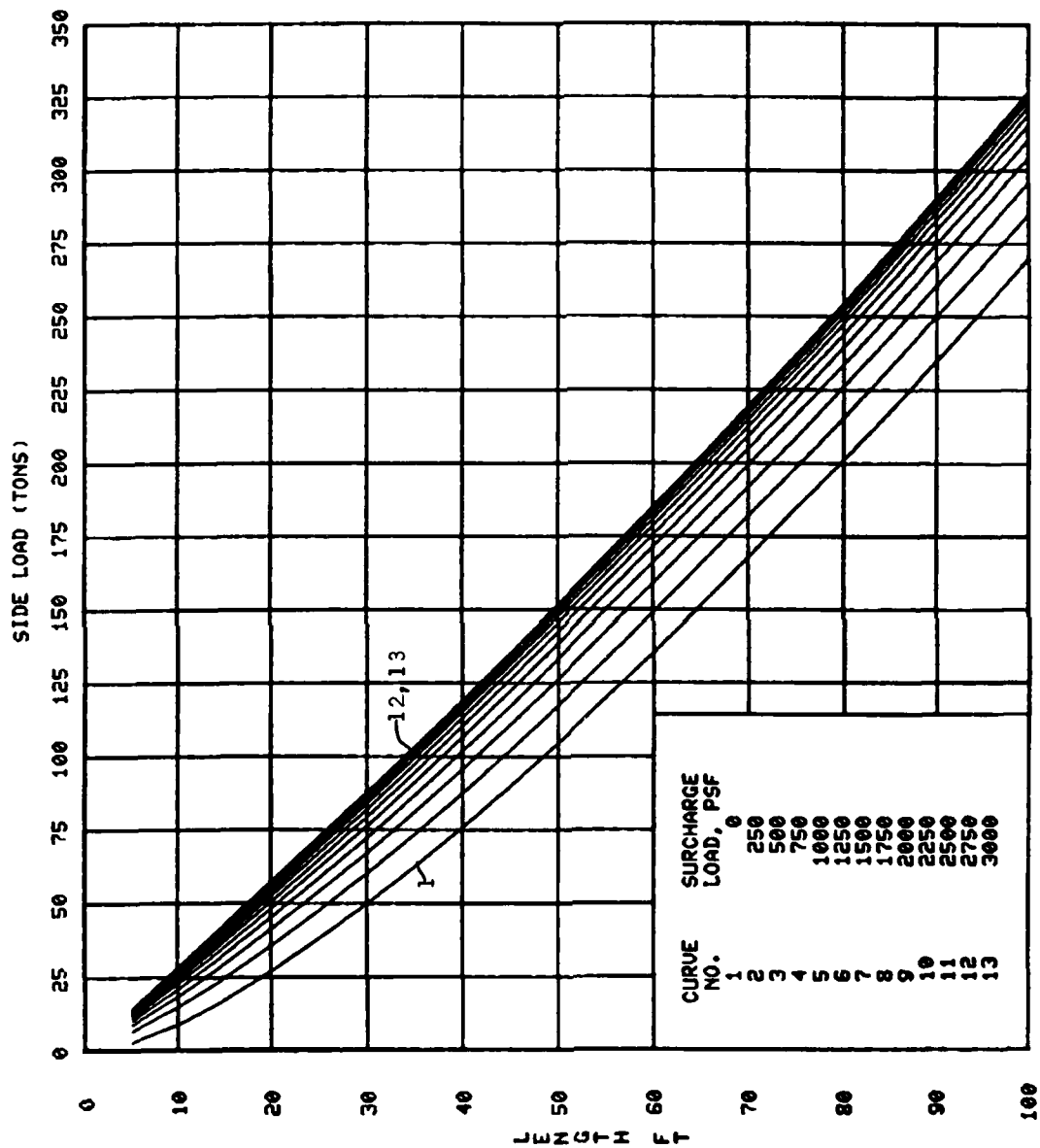


Figure 265. Side Capacity For A 14-in Concrete Filled Pipe Pile Submerged Condition, 1/4-in. Tip Movement,  $\Phi=37^\circ$ ,  $C=0$ .



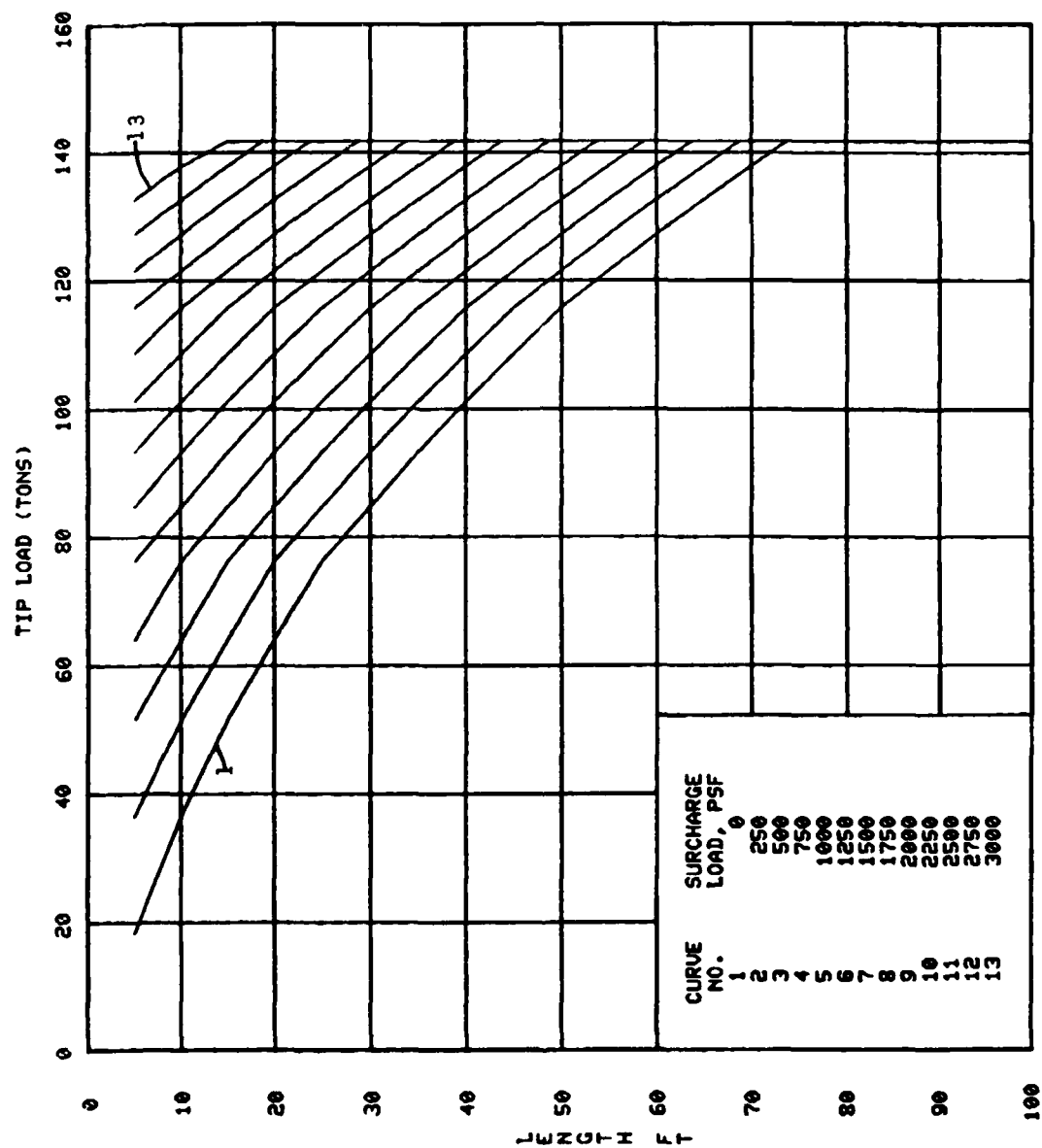


Figure 266. Tip Capacity For A 14-in Concrete Filled Pipe Pile  
Submerged Condition, 1/4-in. Tip Movement,  $\Phi=37^\circ$ , C-0.



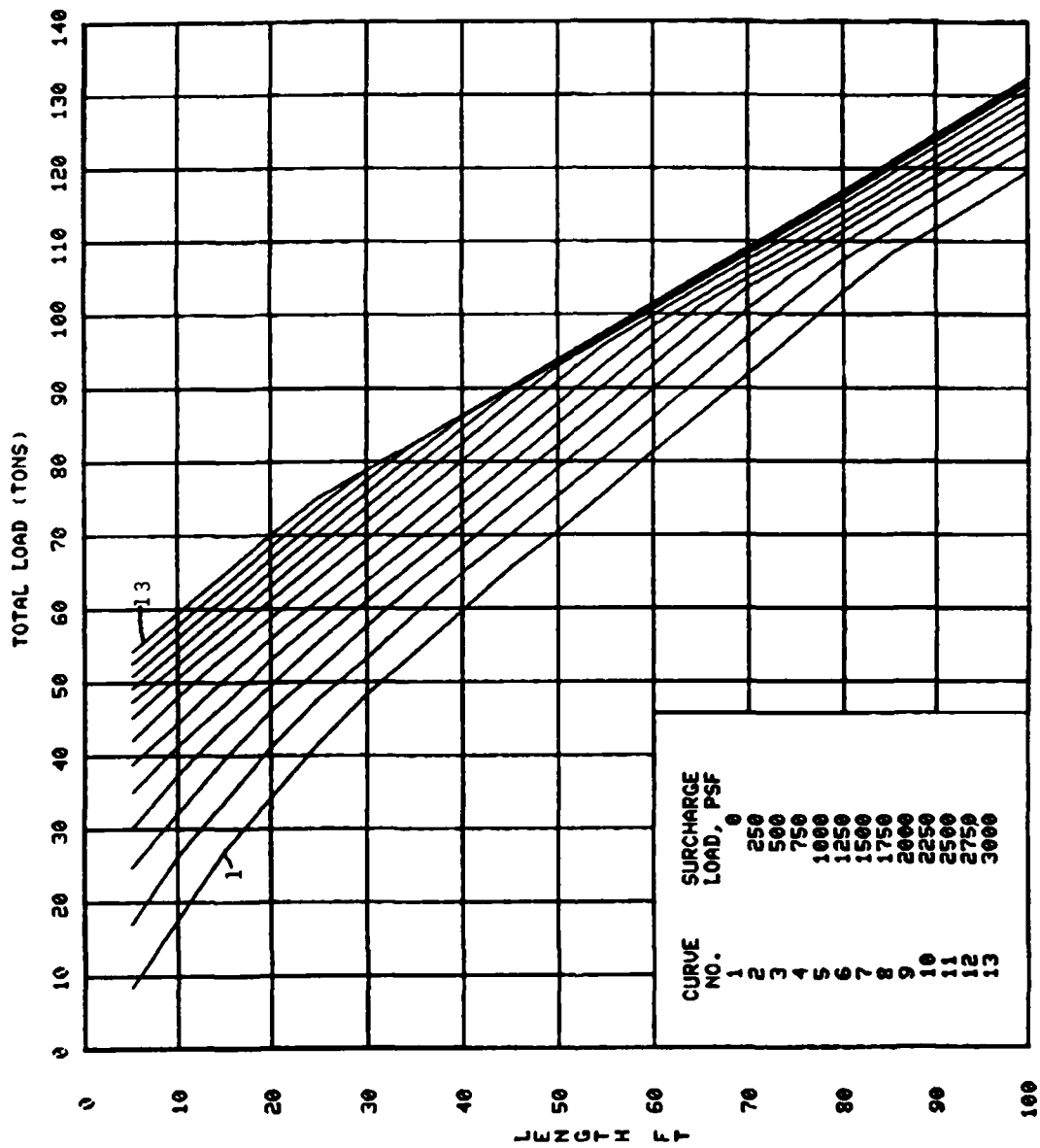


Figure 267. Total Pile Capacity For A 16-in Concrete Filled Pipe Pile Submerged Condition, 1/4-in. Tip Movement,  $\phi=30$  Deg.,  $C=0$ .



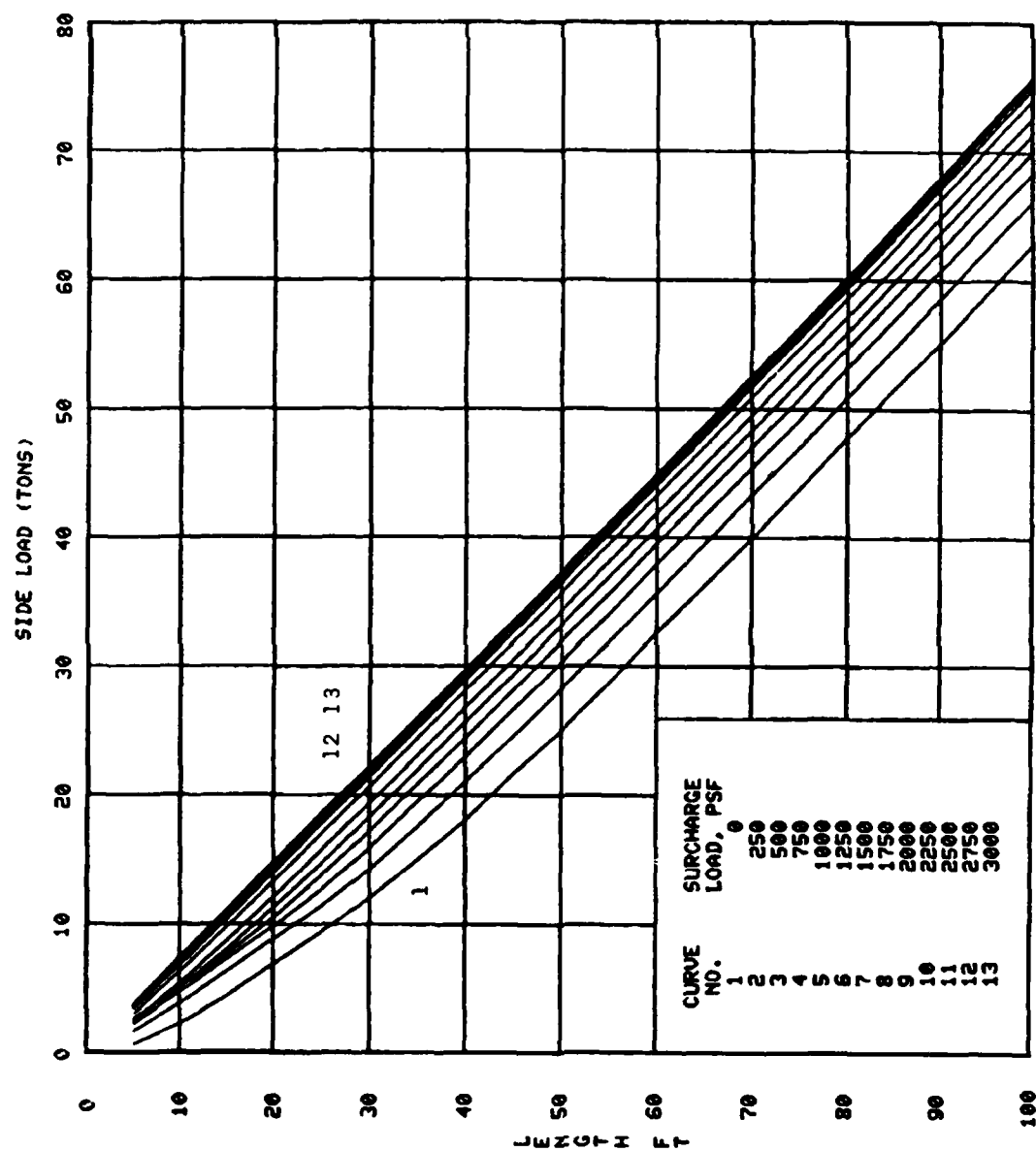


Figure 268. Side Capacity For A 16-in Concrete Filled Pipe Pile Submerged Condition, 1/4-in. Tip Movement,  $\phi = 30^\circ$ ,  $C = 0$ .



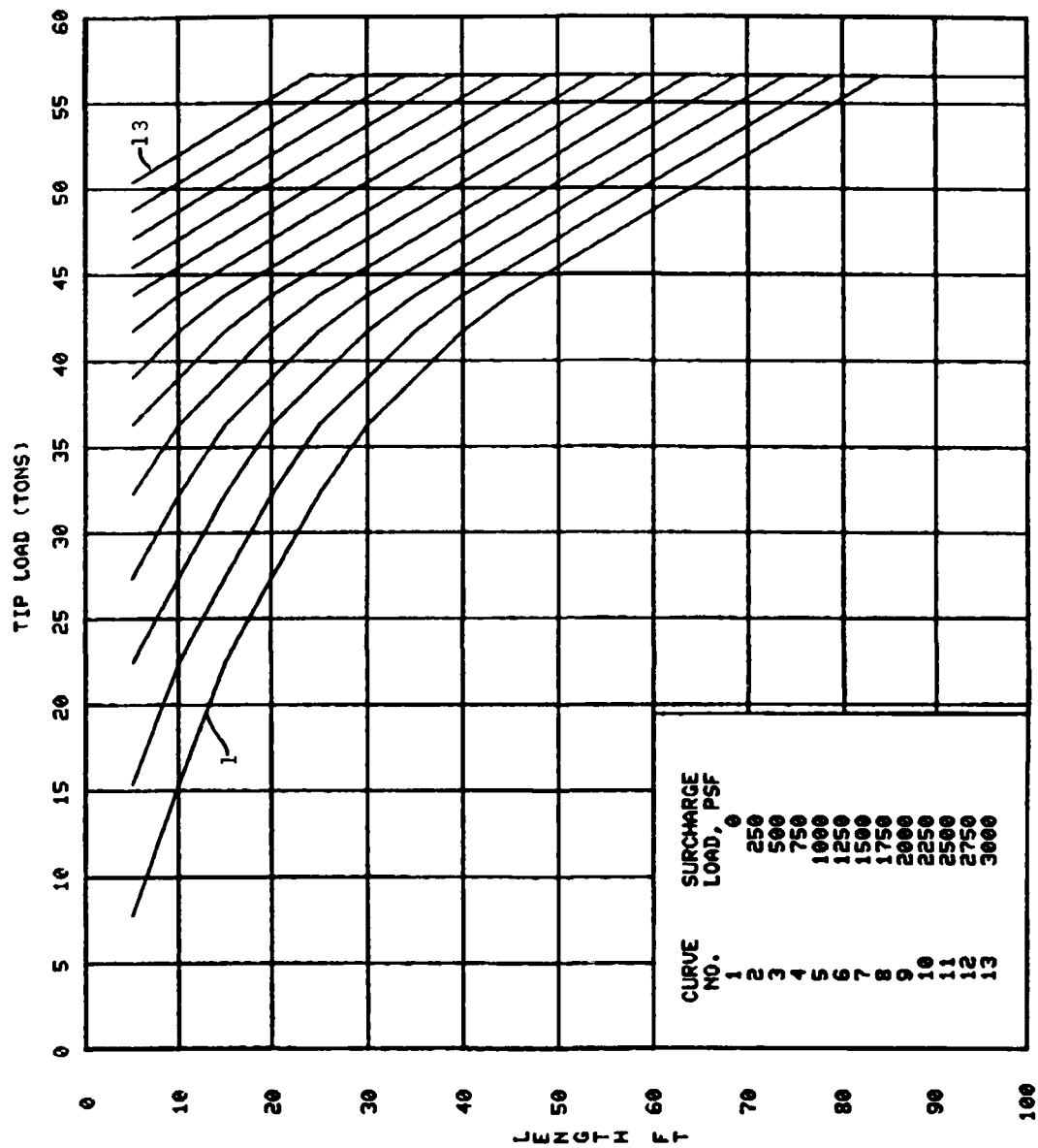


Figure 269. Tip Capacity For A 16-in Concrete Filled Pipe Pile Submerged Condition, 1/4-in. Tip Movement,  $\Phi=30$  Deg., C-0.



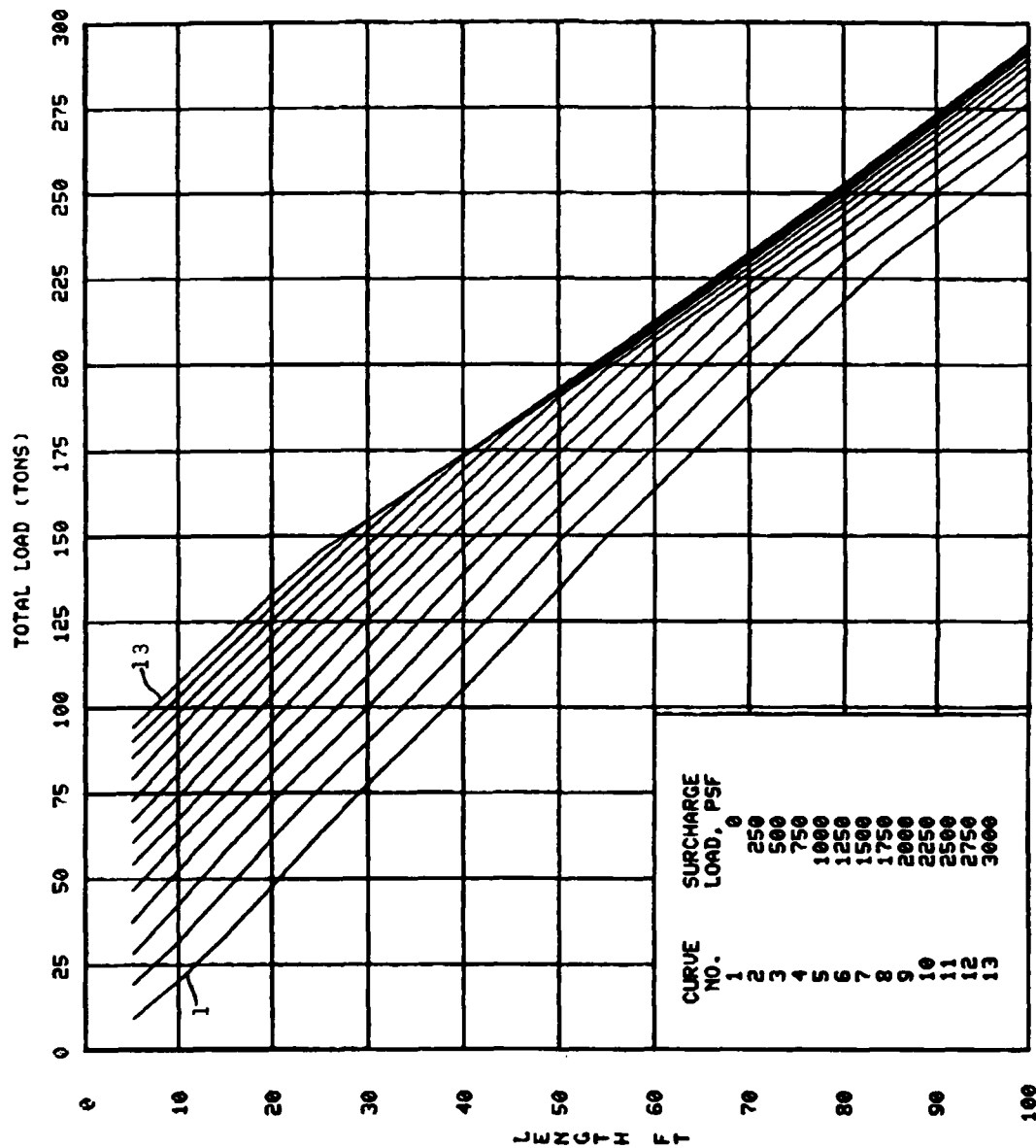


Figure 270. Total Pile Capacity For A 16-in Concrete Filled Pipe Pile Submerged Condition, 1/4-in. Tip Movement,  $\Phi=33$  Deg., C-0.



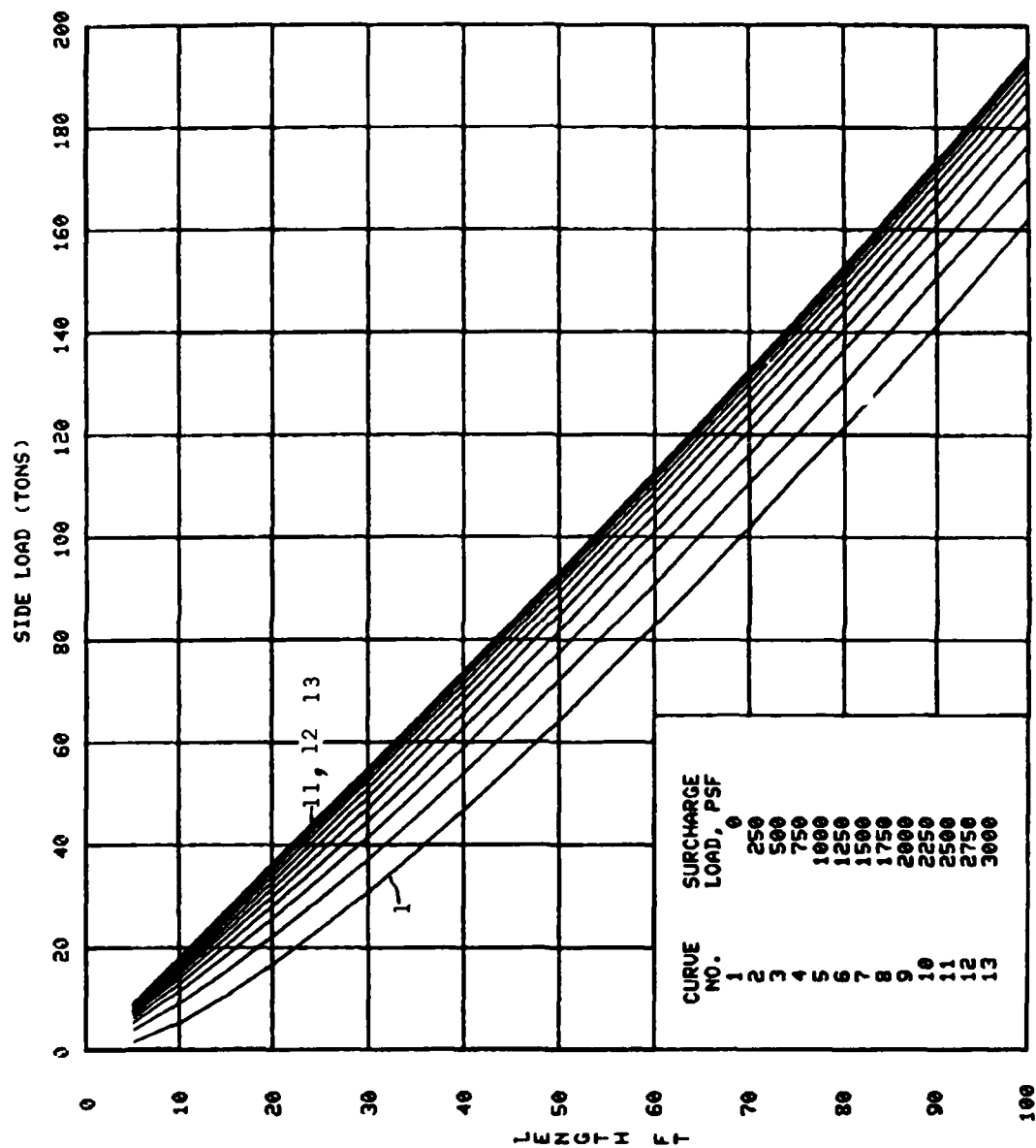


Figure 271. Side Capacity For A 16-In Concrete Filled Pipe Pile Submerged Condition, 1/4-In. Tip Movement,  $\Phi=33$  Deg.,  $C=0$ .



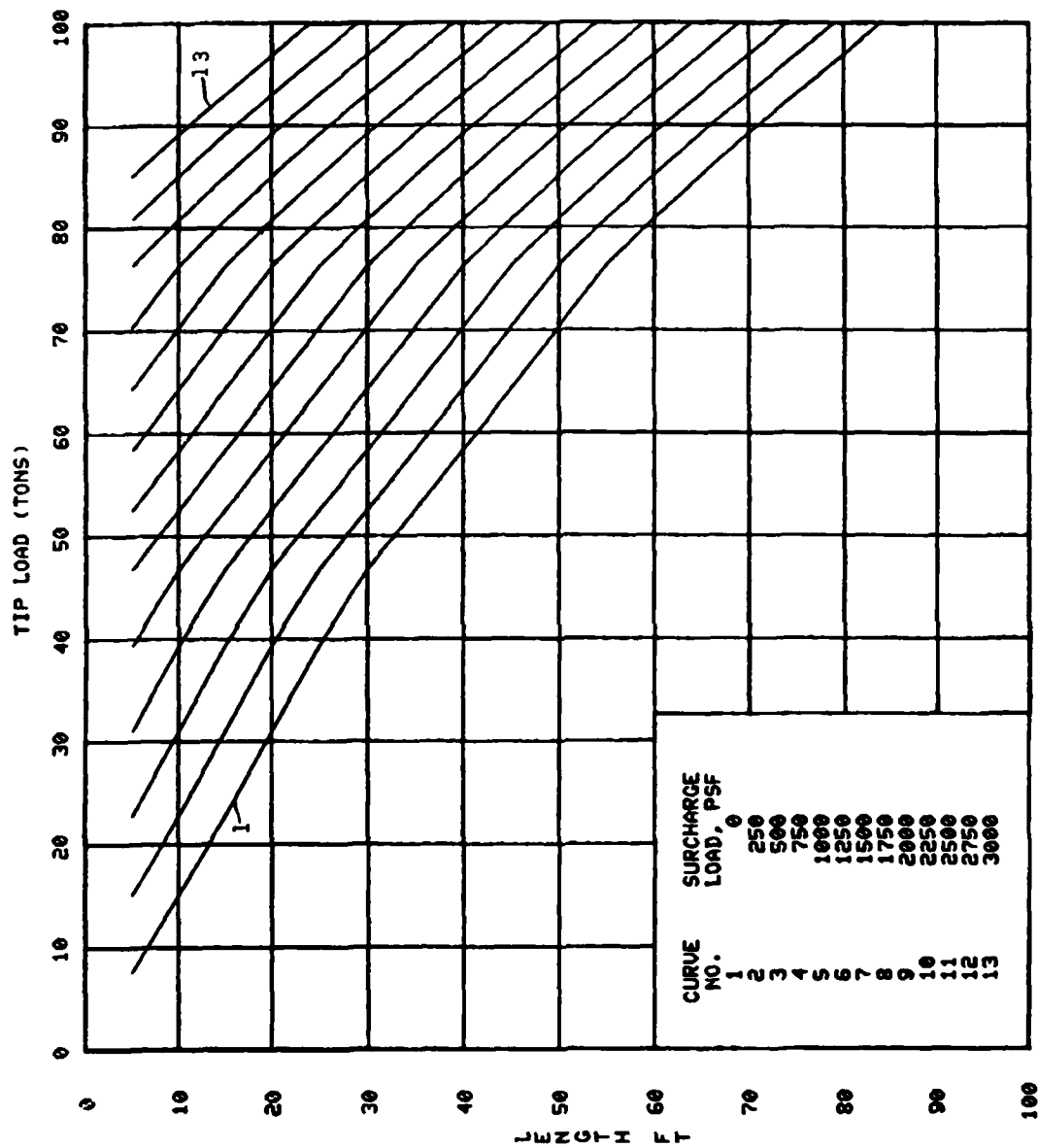


Figure 272. Tip Capacity For A 16-in Concrete Filled Pipe Pile Submerged Condition, 1/4-in. Tip Movement,  $\Phi=33$  Deg.,  $C=0$ .



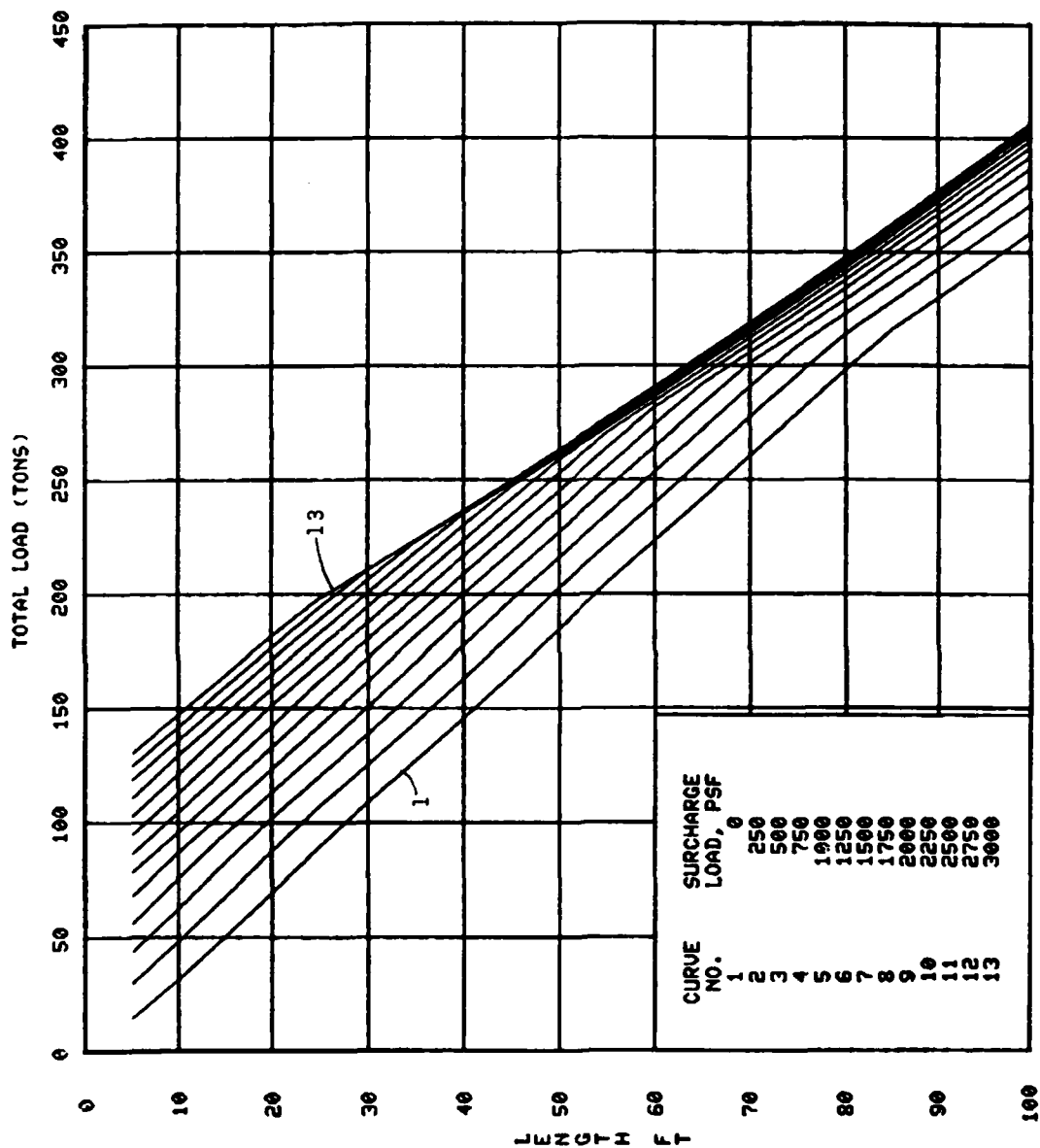


Figure 273. Total Pile Capacity For A 16-in Concrete Filled Pipe Pile Submerged Condition, 1/4-in. Tip Movement,  $\Phi=35^\circ$ ,  $C=0$ .



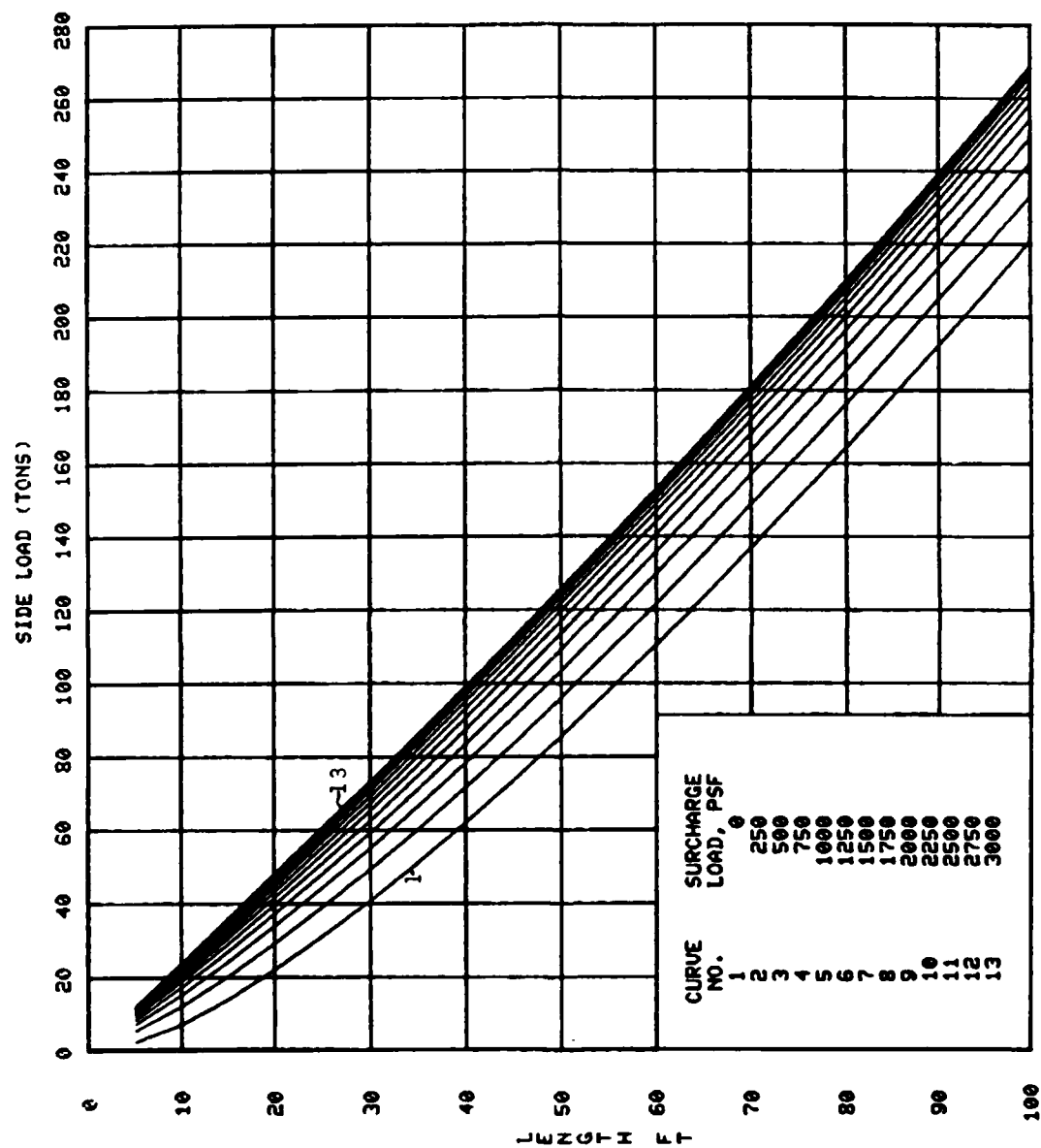


Figure 274. Side Capacity For A 16-in Concrete Filled Pipe Pile  
Submerged Condition, 1/4-in. Tip Movement,  $\Phi=35^\circ$ ,  $C=0$ .



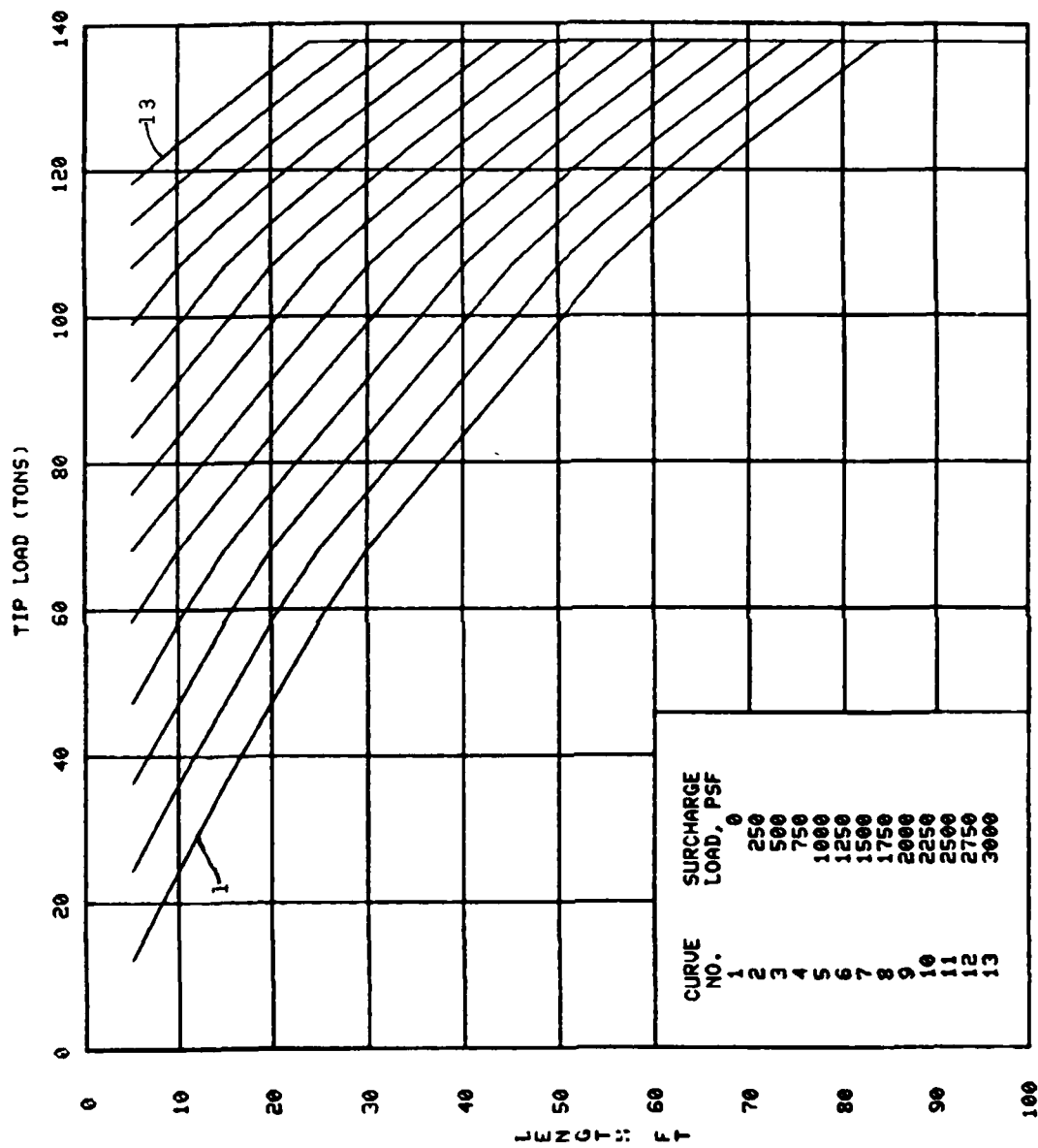


Figure 275. Tip Capacity For A 16-in Concrete Filled Pipe Pile Submerged Condition, 1/4-in. Tip Movement,  $\Phi=35$  Deg.,  $C=0$ .



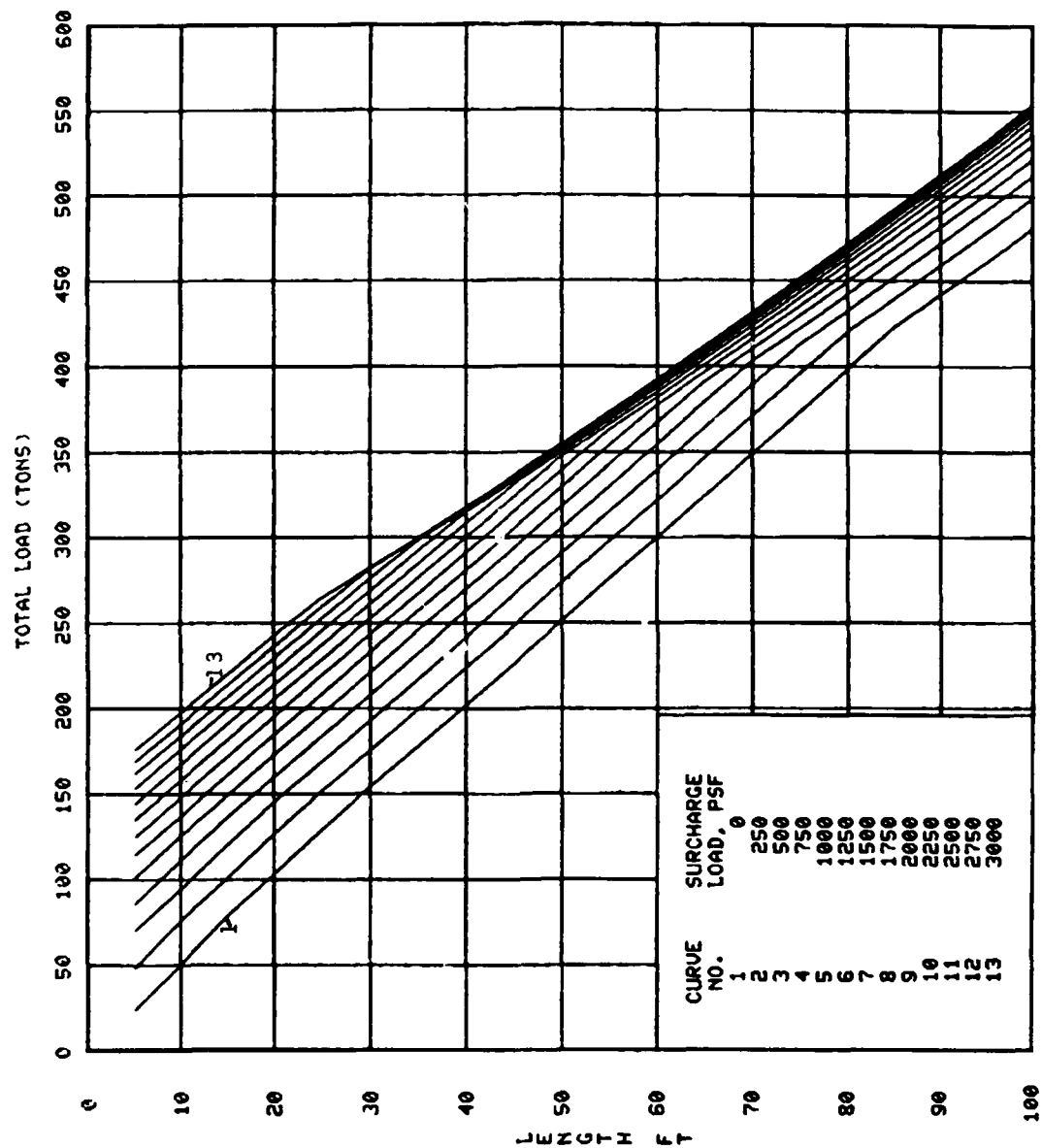


Figure 276. Total Pile Capacity For A 16-in Concrete Filled Pipe Pile Submerged Condition, 1/4-in. Tip Movement,  $\Phi=37^\circ$  Deg.,  $C=0$ .







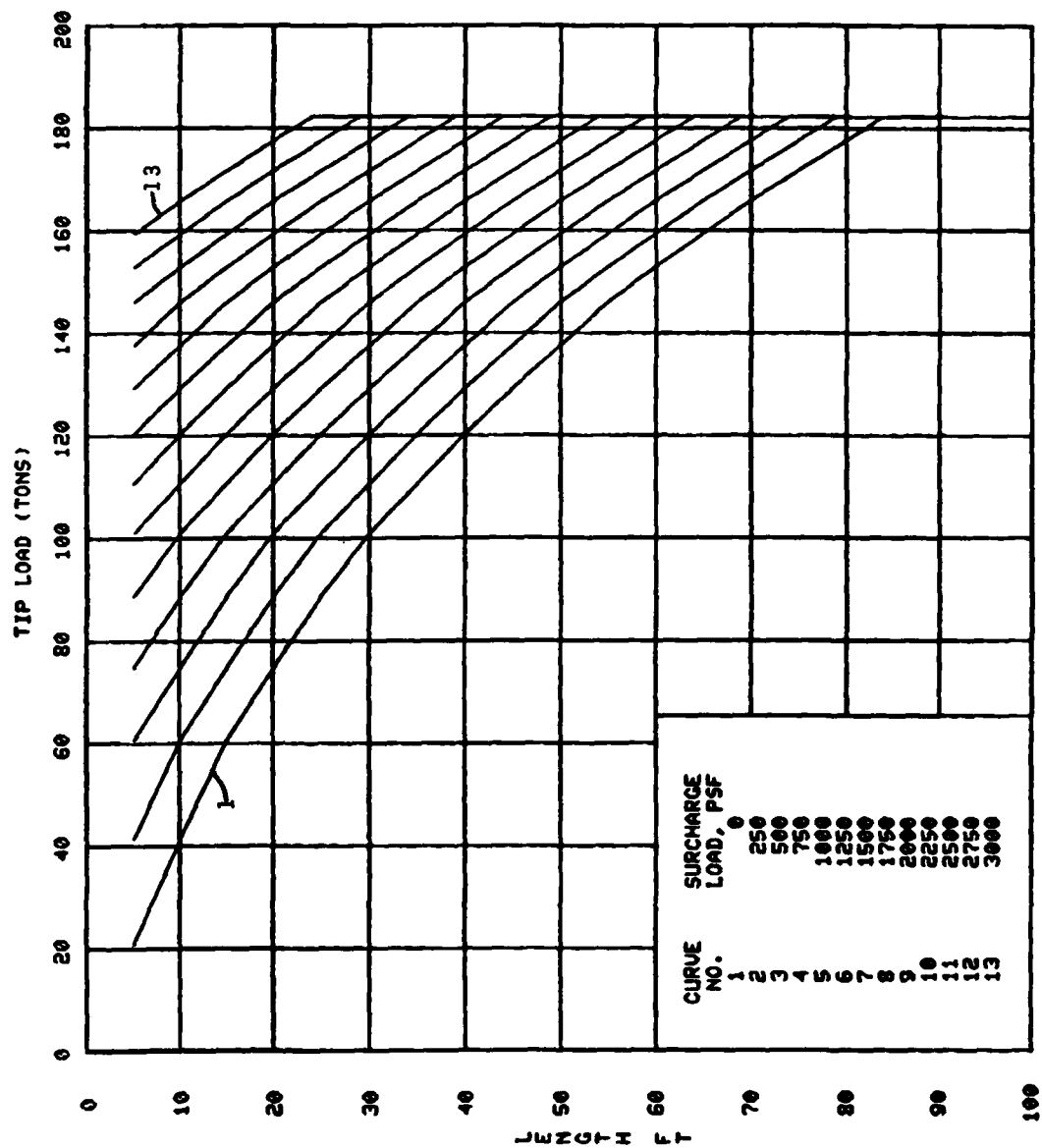


Figure 278. Tip Capacity For A 16-in Concrete Filled Pipe Pile  
Submerged Condition,  $1/4$ -in. Tip Movement,  $\Phi=37$  Deg.,  $C=0$ .